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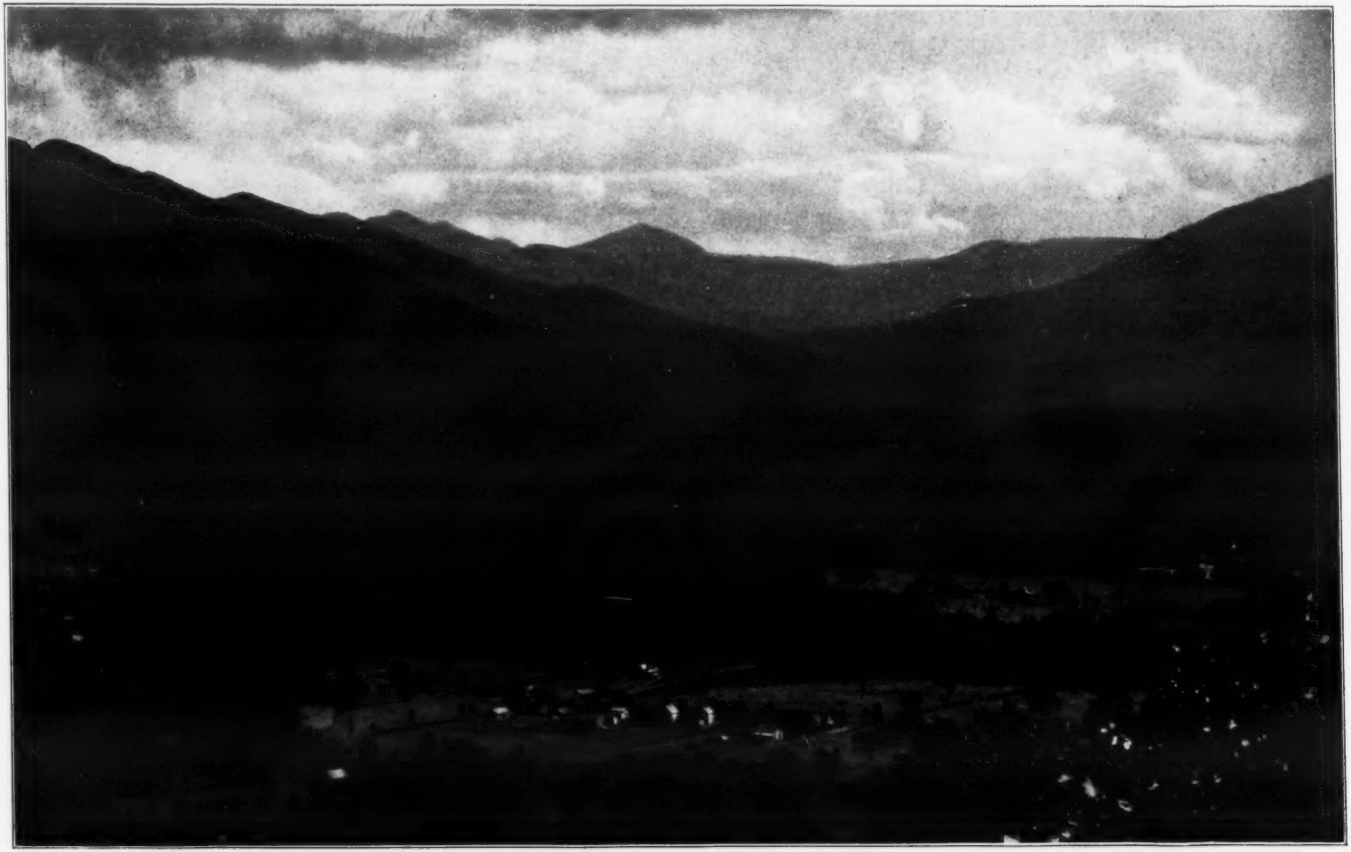


Keene Valley in the Adirondacks (see page 207)

AMERICAN FORESTRY

Vol. XVI APRIL, 1910 No. 4

CHECKING FLOODS IN THE FRENCH ALPS

By BARRINGTON MOORE, M.F., United States Forest Service

I

DOUBTLESS we all have seen accounts of terrible losses and suffering caused by floods in France, not only in Paris but throughout the whole country. We must also have seen in all the papers and periodicals, particularly in *Collier's,* that the conservation policy so splendidly started by Gifford Pinchot and so ably backed by Theodore Roosevelt, which from its very beginning has from time to time been attacked by all the large interests, is now undergoing the fiercest test to which it has ever been subjected.

The connection between the two occurrences may not at once be apparent to the man who reads as he runs. But to those who have given the matter more than a passing thought there is a vitally important lesson to be learned.

The lesson is that if France had had a conservation policy a good many years ago, the damage caused by the recent floods would have been greatly lessened. It cannot be asserted that the flood which inundated Paris was due entirely or even chiefly to deforestation, since in the case of Paris so many different factors, such as the situation of the city immediately in the river bed and the particularly porous nature of the rock and soil comprising that part of France drained by the Seine, must be taken into consideration. But at the same time it cannot be denied that equally destructive floods did occur and often have occurred before in less conspicuous parts of the country, and that these floods were largely if not entirely, due to the effects of deforestation.

It is therefore no exaggeration to say that if the people of the United States allow their present attempts to establish a conservation policy to be blocked by the big interests, large areas of our country will be subjected to the same dangers.

Hence a short account of the damage caused by these floods in the French Alps and of the costly work which is being done to prevent the future occurrence of this damage may be of some assistance in forming an opinion as to the importance of the conservation movement in the United States.

II. HISTORICAL

Before the French Revolution the mountains of France (chiefly the Alps in southeastern France) were well covered with forests which belonged to the crown and to the nobility. When the king and his courtiers were swept away by the rising tide of revolution, their possessions were swept with them into the all devouring maw of the communes and private individuals. The result was the wholesale destruction of the forests, as might have been ex-

CHECKING FLOODS IN THE FRENCH ALPS

Holding the slopes by strips of willow and grass after completion of engineering work. The barrages in the stream channel have become so covered with loose rock as to be inconspicuous

pected when an extremely paternalistic form of government is succeeded by an extremely *laissez-faire* or individualistic form. It may be noticed in passing that this extreme *laissez-faire* policy has persisted to the present day not only in France but more particularly in the United States. And it has been only within the last few years that the people of this country have begun to realize that, although the policy of giving the individual a free hand and encouraging him in every possible way is essential to the development of a new country, yet when that country is once pretty well built up, there are certain limits beyond which the individual should not be allowed to go without a certain small measure of restraint.

In France a considerable period elapsed before the effects of this deforestation was felt. But gradually a realization of the extent of the damage from which the people were suffering was brought home to them. Certain rivers which formed important arteries of commerce were being silted up and were thus choking the commerce dependent upon them, and many prosperous little villages in the mountains were threatened with destruction by over-hanging masses of earth and rock. In many cases small streams from these mountains had become intermittent raging torrents carrying down enormous boulders and masses of debris to overwhelm the prosperous communities in the valley, causing not infrequent losses of human life.

By 1882 public sentiment had become so strong that a bill was passed authorizing work to be carried on to prevent these floods, and appropriating $600,000 annually for this purpose. Thus in addition to the incalculable damage already suffered a heavy expense was to be incurred, for it must be remembered that this annual expense would inevitably extend over a considerable period of years. Already at least $17,000,000 have been spent and an enormous amount of work of far reaching benefit to the country as a

Planting Pine Trees on Steep Slope

whole has been done. The French people are now suffering from a mistake for which they were not to blame. They could not foresee, when they inaugurated the idea of giving the individual an absolutely free hand, that the individual would destroy the forests, nor did they know at that time that even if the forests were destroyed such disastrous consequences would follow.

III

The work being done in those lofty, rugged mounains to prevent the ordinary small and harmless streams from becoming raging torrents, which cut away the mountain sides and carry the debris down on to the fields be'ow each time a heavy rain occurs or the snow melts, is intensely interesting.

The work is really of two distinct kinds, the first consisting of engineering feats in checking the force of the torrents and preventing them from washing away the slopes and carrying down large quantities of debris, and the second consisting of gradual reforestation of the slopes in order to eventually make the engineering work unnecessary.

The first work is absolutely essential because, until the streams have been held in check and the slopes prevented from continually slipping, reforestation is impossible. When the slopes have been given a certain degree of permanence, reforestation is begun by first planting strips of grass and willow in horizontal lines around the slope. When the success of these strips gives reasonable assurance that there will probably be no more slipping, the final step of planting the slope with trees, chiefly pine and larch, is taken. But until the forest has finally become firmly established, there is the continual danger that the engineering work will be torn out by an unusual freshet and the whole work have to be done over again. Several cases where this occurred were seen.

The basis of the engineering work is the "barrage," a dam of dry stone or mortar masonry built in the bed of the stream. The first work on any stream consists of placing a series of these "barrages" at certain regular intervals in the stream bed in such a way that the profile formed by a line along their spillways will give the angle of slope which it is desired the stream bed shall have. These "barrages" fill in above with debris so that if successful they actually form part of the stream bed. The type of "barrage" varies greatly; but in general those on the upper slopes are small and built of dry stone, whereas those in the lower part of the stream are built of dressed stones and mortar and are larger and much more costly.

IV

In order to show more clearly how this work is done, the difficulties

TORRENT OF LES GORGETTES

The upper basin, showing a series of barrages and some of the boulders which the stream carries down with it; also showing steep, almost bare slopes. The patches of vegetation seen are rapidly slipping down into the stream bed

encountered will be roughly divided into three broad classes and an example given under each class. The classes are:

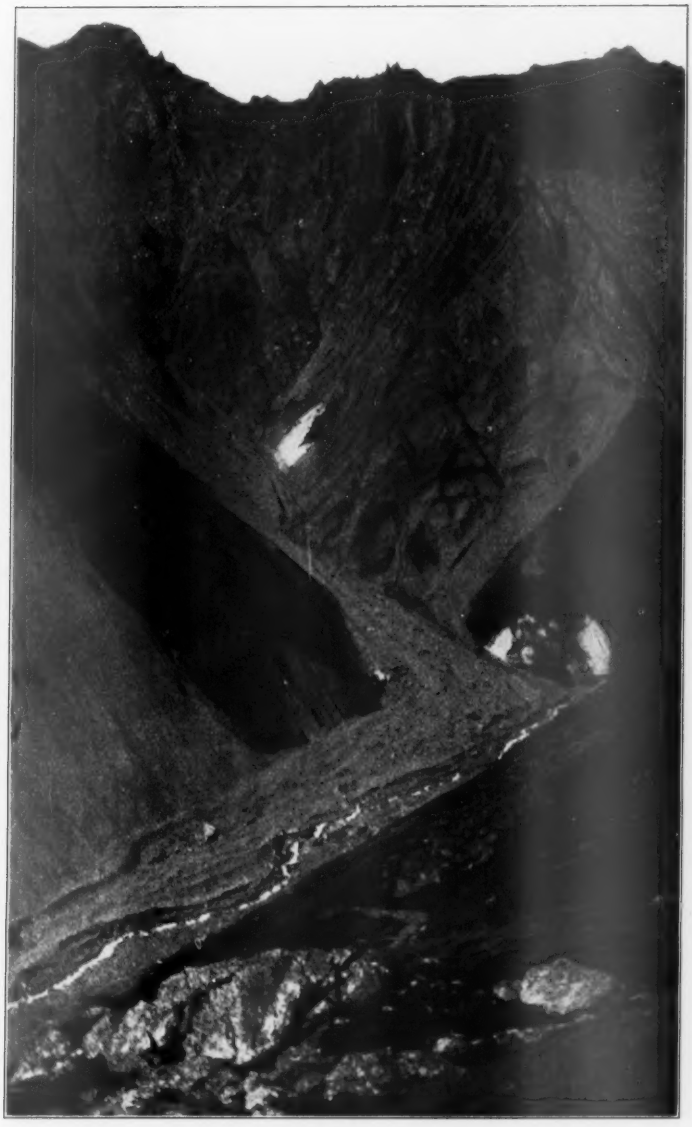
1. Prevention of straight cutting down. This is generally on very steep slopes of a more or less loose and gravelly nature.

2. Bodily slipping of large masses, often many acres in extent, to be prevented.

3. Combination of straight cutting down and bodily slipping.

1. Prevention of straight cutting down. A typical example of this is the torrent of Les Gorgettes near Grenoble. This torrent, though small, is extremely steep and was very destructive before being taken in hand. It repeatedly cut an important highway and ruined considerable areas of valuable agricultural land by its deposits of large boulders and sand.

The work, which was begun years ago, consists chiefly in the building of a series of stone "barrages" in the tributaries on the steep slope forming the catchment area of the stream and in the main channel of the stream itself. These are designed chiefly to prevent further cutting down because the deepening of its bed by the stream naturally involves further crumbling of the already too steep slopes on either side. These barrages are placed at such frequent intervals in the upper and steeper parts of the stream bed that, as one looks up stream, they give the impression of a channel of solid stone. Along the base of some slopes, walls have been constructed to prevent the slipping down of large masses of soil; in other parts of the torrent stone wings may be seen extending out into the stream to turn the force of the current away from precariously loose banks. As one walks along the rugged path up toward the catchment area at the head of the stream, he will notice clearly marked lines on the rocky almost perpendicular slopes above him. These are made



TORRENT OF LES AIGUILLES

So steep that nothing can be done with it. Notice the enormous quantity of material which it carries down (see page 204)

TORRENT OF ST. MARTIN

Large barrage, crushed for the fourth time by lateral pressure

by aspen and alder cuttings which have been planted to hold the loose soil on the slope as much as possible. (How any human being ever kept himself on those hillsides to do the planting without wings is a mystery.) These early attempts at planting, however, do not appear to be very successful and probably will not be until the slope has acquired the "angle of repose."

In the case of Les Gorgettes, floods still occur and carry away parts of some of the "barrages," and the steep slopes are still crumbling down into the torrent. But it is considered that further cutting down of its bed by the torrent has been checked and that therefore the first and most dangerous part of the work is over. The final step will be to reforest the slopes as soon as they become sufficiently permanent.

Thus, after a long period of years, through terribly hard and often dangerous work, and the expenditure of large sums of money, the forest about this stream bed may be brought to what it was before private individuals were given a free hand.

Unfortunately the case of Les Gorgettes is simple compared with some of the others. In a different part of the mountains not far from Grenoble, near the quaint little village of Vaujany, is a torrent called Les Aiguilles, meaning "The Needles" on account of its numerous sharp points. All attempts to control this torrent have failed, and the cutting will have to be allowed to continue till the slopes have worn themselves down to a more gentle angle.

2. Bodily slipping of large masses. The best example seen of this difficult proposition was the torrent of St. Martin. This is in Savoy near the famous Mount Cenis pass through the Alps into Italy. The torrent rises in a steep basin at about 8,000 feet elevation, flowing through rather gently sloping pastures and then down a steep pitch into the main river at about 3,000 feet, a total drop of about 5,000 feet. The great difficulty occurs where it would least be expected. The large innocent looking pastures are composed of a kind of loose slatey gypsum soil which becomes saturated with water, causing large areas to slip in a body gradually but irresistibly downward toward the banks of the stream. Of the "barrages" built in the bed of the torrent one of the largest, eighteen feet high by ten feet thick, had been crushed and rebuilt three times and when seen had been crushed again for the fourth time by the terrific lateral pressure. The numerous smaller "barrages" had been

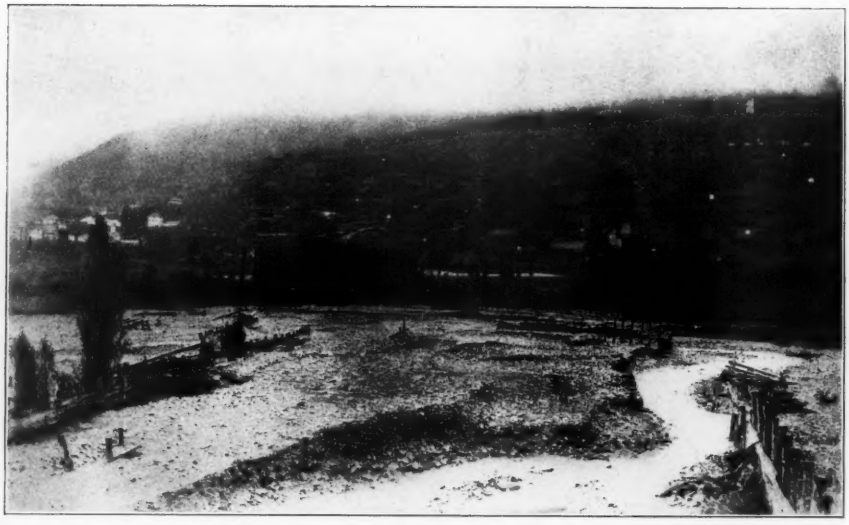
TORRENT OF ST. MOREL

Large crevasses formed on the edge of the plateau at the head of the ruined slope (not visible in the picture), and part of the plateau slipping bodily in such a way as to threaten the village near its edge

hopelessly broken up and carried bodily downstream for lack of a foundation. On the lower steep pitch of the torrent the whole hill is slipping bodily at the rate of twenty or thirty feet per year. Here a set of "barrages" costing $11,000, had been so completely destroyed that scarcely a trace of them could be seen.

With such conditions "barrages" are of no avail. The only remedy lies in an elaborate system of underground drains covering the entire slopes affected. Naturally this involves an enormous expense and the drains when once built will require constant attention, because if once they become stopped up the hill will start on its downward course again. Though the work of checking this torrent was first undertaken in 1888, work on the drains has only just begun, and it will be a number of years before the people living in the vicinity of the torrent of St. Martin will be able to enjoy a sense of security.

3. Combination of straight cutting down and bodily slipping. In most of the torrents examples of this combination of conditions can be found to a greater or lesser extent. But the magnitude of destructive power of the combination is best seen in the torrent of St. Morel. This stream has been rising at frequent intervals, and at each rise has swept away large portions of the base of a slope almost a mile long above its left bank. It has done this so often that this large once fertile slope has become a mass of bare and loosened gravel. Even worse than the destruction of this hillside is the danger to two prosperous villages on a plateau above it. A large crevasse has opened at the top of the slope on the edge of the plateau and another one further back on the plateau itself. This is causing a large section of the nearly level land only a short distance from one of the villages to slip bodily towards the bed of the torrent. In addition to this destruction and danger certain prosperous communities near the mouth of the torrent were constantly threatened with being overwhelmed by masses of debris; and the Isère and Rhone Rivers were being silted up to such an extent that commerce was impeded. When work on this torrent was first begun, attempts were made to check its ravages by the usual system of "barrages." All these attempts proved failures. Finally as a last resort and in order to remedy the trouble



TORRENT OF ST. MOREL

The lower part of the torrent spreading out and ruining fertile agricultural land; showing ineffectual fences built by the communes below for protection

once for all the stream was turned entirely away from the threatened slope by piercing a tunnel through the rock on the opposite side. It was necessary not only to cut the tunnel almost a kilometer (six-tenths of a mile) long but to line it throughout with masonry at a total cost of $260,000. In addition to the actual money spent several lives were lost in building this tunnel. As the result of this work the slope which had been undermined will in all probability continue to slip until it has filled up the former stream bed and reached the angle of repose with its base supported against the cliff on the opposite side. All danger of further slipping will then have disappeared. The lower course of the stream will be prevented from committing any further ravages on the fertile plain with its wantonly distributed and all destroying deposits of boulders and gravel, by means of a stone channel through which it will henceforth be forced to flow.

Thus after the expenditure of large sums of money and the loss of human lives, the torrent of St. Morel is at last controlled.

Considering the work as a whole, the public spiritedness as well as the skill, energy and pluck which the French people have shown in dealing with this difficult and far-reaching condition of affairs deserves the highest praise and should serve as an inspiration to other nations if they ever become afflicted with the same misfortunes. Fortunately, we in the United States have not yet reached this stage. But there are parts of this country, notably in the Southern Appalachians and White Mountains where such conditions are not only possible but very probable unless action is taken on certain bills which are now before Congress aiming at the preservation of these all important watersheds.

At the end of the eighteenth century, the French people made a mistake from which they are suffering to-day and are likely to suffer for many years to come. This mistake was made at a time when the scant knowledge of political economy made it natural and excusable. In the United States to-day there is not the same excuse for committing the same blunder.

TORRENT OF ST. MOREL

Looking up the lower part of the stream, showing how it will henceforth be kept in a stone channel

KEENE VALLEY IN THE ADIRONDACKS

Our frontispiece of Keene Valley in the Adirondacks, from an admirable photograph by George Parker, shows the group of highest mountains, Mt. Marcy, The Gothics, Wolf-jaws; to the northwest, Mt. Porter and Table-top. Starting on Mt. Marcy, a large stream, known as John's Brook, flows down through the valley, emptying into the Au Sable River at the foreground. It is one of the most important watersheds in that region. The Rogers Company of Au Sable Falls is conducting a four-years' pulp job, taking every tree down to three inches in size. Already the stream shows the effect of it. In addition to their work, the fires have run through this region, so that there is a strip for about two miles on either side of the brook nearly bare. The company has built a seven-mile road to bring down the pulp through presumably impassable country.

CHECKING FLOODS IN THE FRENCH ALPS

Reforestation complete; one of the lower barrages in the formerly destructive torrent of La Grollay, now completely controlled by forest cover. Few cases in France have reached such a satisfactory stage

THE INFLUENCE OF FORESTS ON CLIMATE AND FLOODS

IN DECEMBER, while the hearings on the appropriations for the Department of Agriculture were being held by the House Committee on Agriculture, Prof. Willis L. Moore, chief of the Weather Bureau, made some statements on the above subject to the committee, and these, at the request of the committee were later expanded into a printed report and sent out all over the country. The press was also urged to give it as much publicity as possible. This action was so timed as to make it appear like an attempt to discredit the proposed Appalachian forest legislation, and such was no doubt its intention. No other motive could explain such a studied effort at this time.

As Mr. Moore is a government official and other officials of coordinate bureaus, better qualified to deal with this subject, are estopped from discussing it by the present rules of the executive departments, this method of campaigning is somewhat one-sided and unfair. In order that the case, which is one of vast and increasing importance to the country, should be fairly presented, we have requested certain experts of recognized authority in their special fields to discuss the Moore report directly. We are fortunately able to present this month three papers by a forester, a geologist, and an engineer, each of whom has given this subject long and careful study.—THE EDITORS.

THE APPALACHIAN FORESTS AND THE MOORE REPORT

By FILIBERT ROTH, Professor of Forestry in the University of Michigan

THE friends of forestry, the advocates of conservation, and with them the people of the United States, east and west, north and south alike, are before Congress with a simple and modest request asking for a law which shall preserve the forests of the Appalachians, both north (White Mountains) and south.

The reasons for this request are primarily:

1. All the lands of these mountains are in private hands and the forests are cut by man and devastated by fires as fast as the owners find it practicable and profitable to do so.

2. This devastation of our forests in the eastern United States has converted millions of acres of forest into unsightly and unused waste lands; it has ruined whole countries in the level districts of the Lake region; it has ruined entire mountain ridges in Pennsylvania; it has ruined thousands of acres of the very mountains under consideration and is to-day extending clear up to timber line in that most famous of all our mountain tracts, the Presidential Range, stretching its hideous hand of pillage and destruction up the slopes of Mts. Madison, Jefferson and Washington, the grand old domes, dear to millions of our people.

3. Unless the government interferes, this devastation will continue with increasing rapidity and it will be but few years when practically all of these mountain lands will be denuded of their protective forest cover.

4. This denudation of the mountains in many places has resulted in a com-

FOREST SCENE IN THE SOUTHERN APPALACHIAN REGION

Compare the French forest on page 208, recreated at great cost, because necessary

plete removal of all soil, laying bare the solid rock and thus preventing all future forest growth. In other places thousands of acres have been washed into unsightly and useless gully lands, and throughout the mountains and over thousands of acres, all intermediate stages of erosion, deterioration and destruction can be seen.

5. This erosion and gullying has produced natural paths for the water and during every rain or thaw the waters rush down through these channels and thus leave the ground and the moun-

tains far more rapidly than they would if these innumerable gullies, runs, or natural ditches did not exist. Man, in other words, is causing the natural digging of drains on land where no sane man would wish to have a drain, but where common sense would indicate the necessity of creating every possible obstacle and every means which would keep the waters from gathering into runs and from rushing into the streams and out of the mountains.

6. The faster the waters collect and rush down the slopes, the more they erode the land and the more powerful they are to carry away the soil, so that this evil is one which not only continues but is getting worse the longer it lasts.

7. The earth which is thus washed out in the creation of these gullies and in the removal of soils from the slopes is rushed into the streams and sooner or later finds its way into the navigable parts of the rivers below, where every inch of depth of water is precious.

8. With the forests and other obstacles removed and with innumerable ruts, gullies and runs facilitating its speedy run-off, the waters rush from the mountains much faster and therefore have less time to soak into the earth. But in times of little or no rain, the streams depend for their supply largely, often entirely, on water which has been stored in the soil and which slowly, but steadily, seeps out to feed the streams. The rushing off of the waters on the surface and in the drains and runs reduces the storage of water and this means less water during low water times: it means less water in the rivers, at the very time when most needed.

9. The forests of these mountains have been and should be a great and permanent condition covering eighty-five to ninety per cent of all the mountain area. This is the natural condition; its establishment and maintenance therefore are not matters of costly construction and doubtful utility like artificial reservoirs. It grows of its own accord, and all it asks is that man shall not wilfully destroy it.

10. The establishment and maintenance of a forest cover on these mountains will not be a great expense to the people. The forests on these mountains, in due time, will be self supporting and will amply pay back such capital as is put into the purchase of the lands.

11. This forest cover is the only regulator which man can maintain in these mountains, which is assuredly feasible, practicable, and permanent. Some artificial reservoirs, no doubt, will be built in time. An extensive set of such reservoirs would mean displacement of railways, highways, farm homes, etc., it would mean the making of lakes out of the very bottom lands which to-day are the only lands on which farming is successful and permanent. Such reservoirs would mean the building of many dams and bring with them the dangers of flood catastrophies. And in the end all reservoirs would certainly fill up with mud unless the entire system is safeguarded by a forest cover on the mountains.

12. The forest cover is not taking lands which should be used for other purposes, and does not prevent such use at any future time. Though among the oldest settled regions of the country, not five per cent of the real mountain lands are used agriculturally. Wherever farming is successful, it is in the valleys on good bottom and bench lands which would never be disturbed by the enterprise requested.

These mountain forests are valuable in many other ways—they produce timber, they serve as place of recreation to thousands of people, and they are worth millions for their beauty alone, but since Congress believes itself bound by the Constitution to consider the matter from the standpoint of stream regulation, the above reasons are the ones emphasized in support of the "Weeks Bill."

These reasons have evidently appealed to Congress before, for the Senate has at three different times passed a bill for this purpose, and the house has done so once. But again the opposition appears and as its champion the Chief of the Weather Bureau, Willis L. Moore, who in a *"Report on the influence of forest on climate and on floods"*

A Deforested and Eroded Hillside in the Southern Appalachians

seeks to refute the above reasons and the common belief in the influences of the forest. This report was printed at the direction of the House Committee on Agriculture, as is noted on the front page, and was evidently written for the use of this committee. To appear as argument in this connection it may be said that the very title of the paper is misleading. For it makes it appear that there is controversy as to climate and floods when in reality no such discussion exists. There is no one claiming, in connection with this preservation of the Appalachian Mountain forests that they affect the climate of the United States and even the increase of the local rainfall does not appear as an important or general claim. And yet even as to this seemingly simple matter of local rain, Mr. Moore admits (see p. 22): *"It would be difficult to either confirm or disprove this statement of Mr. Willis."* He might have left out his "difficult," and simply admitted that Mr. Willis' statement rests on pure and simple physics, capable of experimental proof and that it is a *fact* which no one can refute. Mr. Moore, however, prefers to add: "Certain it is that the rain is precipitated largely from air masses that exist at a considerable distance from the surface of the earth, etc." just as if he or anyone else could tell whether the water in a rain drop came from Syracuse or Utica or any particular place.

As regards the second part of the title, the "floods," it is evident that this word has been used with widely different meaning, and throughout the paper tends to mislead. There is no one claiming that a forest cover would prevent a cloud burst or one of those remarkable rainstorms where several inches of water fall within an hour and thereby lead to destructive floods (usually merely local) and no one would claim that the forests prevent a disastrous thaw such as we now witness in the Cascades of Washington and elsewhere. These are catastrophies, like a cyclone, and just as we do not expect a house to withstand or prevent such a cyclone, so we do not expect the impossible of the forest. But both the house and the forest do, even during these catastrophies, what they are able

to do, and they usually do a great deal and we believe in them. As stated above, the claim for the forest is that it prevents washing and gullying and in addition it helps to keep the soil in a condition such that water can be stored in the ground; and by its tree tops, its brush and debris it furnishes innumerable obstacles on every acre of ground which prevent the water from gathering rapidly and rushing from the slope. On the Appalachian Mountains this regulator means just these things, and means not merely an occasional affair of a few acres, but means a cover for eighty or ninety per cent of all the land and a cover which is effective, winter and summer, one which never fails, and one which maintains and renews itself. If then, in exceptional years an unusual rainstorm produces extraordinary conditions, the forest will still do its share and it will do all that it ever does, and in many cases this will mean the difference between a "freshet" or high water and a disastrous flood. Similarly it is not claimed that forests can protect reckless people who are determined to build their houses on flood lands and to crowd the river into an impossible channel as has been done in many places. The forest is no panacea, but this fact in no wise lessens its great influence for good.

In his introduction Mr. Moore mentions the fact that this forest protection "may involve the expenditure of hundreds of millions of dollars and the employment for years to come of thousands of public officials."

The first part is a misstatement of facts, and deals with a subject upon which Mr. Moore is evidently incompetent to speak, and the second part is a play on the dislike of our people for officialdom. What this sort of political clap trap has to do with a scientific exposé of forest influences is difficult to see. Certainly there can be no objection to an enterprise which will keep millions of acres of mountain lands in a productive condition rather than allow them to become useless waste lands, simply because it may give employment to many people.

Mr. Moore then proclaims himself a friend of the forest, and says that there are abundant reasons why they should be protected. He then enlarges upon the necessity of having plow land and of feeding our people and says (p. 4): *"I believe that forests should be preserved for themselves alone or not at all."* Just what this means the reader must judge for himself; that it is irrelevant to forest influences, is clear enough.

Again he says (and it is also printed in italics), p. 4:

"And there can be no valid objections to decreasing the area (of forest) where homes and a well-fed people take the place of wild animals and the wilderness." When we remember that these mountains were settled about as much as they now are when Iowa was Indian country, and when we further remember that the real farm lands in the United States are hardly half used and tilled, and that millions of acres of the best of lands are not yet even settled, this statement gets the smack of the campaign document and has certainly no place in a discussion of this kind.

Mr. Moore then proceeds to discuss at length the "effect of forest on climate;" the "dessication of Asia;" "local climatic influences," "influences on temperature" and other utterly irrelevant matter. Incidentally he makes a "plea for tolerance of opinion," and discredits the "recollections of oldest inhabitants."

He then takes up the "effect of forests on flood" and admits, p. 15: *"This is a tangled problem, since the results must depend upon the slope of the ground, the nature and condition of the soil, the nature of the forests, etc."* And further on (p. 16) without any real discussion and without adducing a single important fact we see the remarkable statement: "On the whole, *it is probable* that forests have *little to do* with the heights of floods in main tributaries and principal streams, etc." This sentence printed again in italics for emphasis, with its "probable" and "little to do" is here put forth as conclusive proof and evidently serves as sufficient scientific evi-

dence to support his main conclusions at the end of the paper. These conclusions Nos. 7-9, are the only ones which are really germane to the subject. The first and most important reads as follows:

"No. 7. *'The run-off of our rivers is not materially affected by any other factor than the precipitation.'*" A brand-new discovery in science! We are told, practically, that it makes no difference whether the land is level or hilly, whether the slope is steep or gentle, whether it is rough or smooth, whether it is cleared or covered with brush, whether it is gullied or not, all these factors have no "material" influence, the water runs off in just the same way. The fact that it is the mountain streams which have bothered the people in every part of the world by their turbulence, their floods and droughts is unknown to Mr. Moore. The fact that a prairie river like the Brazos gets on a "rampage," and becomes a mud torrent during a three days heavy rain while a river from the forest, like the Wisconsin will hardly show a rise or sign of turpitude, all this appears to Mr. Moore *mistaken observation,* evidently of the "oldest inhabitant" and the United States Geological Survey. (Which by the way has an hydrographic office which is the only reliable scientific bureau dealing with these subjects.) That this conclusion No. 7 flatly contradicts the statement on page 15 and quoted above, where he admits that slope and soil cover do have something to do with this run-off, does not bother his logic. This conclusion is so extraordinary, so illogical, and devoid of sense, and yet so eminently well fitted to serve the purpose of the whole paper that one is forced to believe that the conclusions were specially framed on the assumption that our "busy" people and legislators read only conclusions. The other two conclusions, Nos. 8 and 9, assert, on no particular proof, that floods and droughts are no more frequent now than formerly, though he admits on page 16: "All of these problems *could be definitely settled* beyond the possibility of argument *if we had accurate river gaugings* from day to day and year to year, etc." He evidently knows that we *have not accurate river gaugings,* but in spite of this is not afraid to assert that he (Mr. Moore) knows whether floods and droughts are more or less frequent. The use of such assertion in a scientific discussion well illustrates the character of the whole paper.

In dealing with "Run-off and absorption" Mr. Moore admits it "to be generally held" that forests affect run-off. He prefers not to discuss this matter, however, claims that plowed fields are the best absorbers, and then contents himself with the above quotations concerning river gaugings and adds, p. 16: *"We must, therefore, reason empirically from the best information at hand and this insufficiency of data* renders less positive the conclusions of all investigators, no matter which side of the question they may be on."

This insufficiency of data evidently does not prevent Mr. Moore from making the most extraordinary assertions ever ventured in any discussion of this kind.

In this very matter of run-off Mr. Moore fails entirely to connect run-off with erosion, the gullying or development of the innumerable drain lines due to clearing of land, and aggravated by plowing.

That every furrow, every rod of gully, acts as a drain and hastens run-off and prevents water storage, does not seem to be of importance to Mr. Moore's position. The average citizen who sees with his own eyes and not merely through the reports of rain gauge readers, and who has come to the same conclusions as his neighbors and thousands of observing people all over the country will wonder if his "reasoning empirically" is not perhaps as convincing as that of Mr. Moore.

In dealing with "Effects of Forests on Floods in France" Mr. Moore deliberately quotes certain authors by extract and is guilty of misleading statements concerning the views of prominent engineers, as is indicated by Professor Swain. He also neglects the main feature of this topic. He does not know or

STEEP, DEFORESTED SLOPE OF MT. MOOSILAUKE, NEW HAMPSHIRE

This formerly bore a noble and valuable protective forest; it is now ready for swift erosion that will permanently destroy its usefulness

is unwilling to tell that European countries generally have accepted the principle of the "protective forest," meaning thereby that forests in certain situations protect the soil and regulate water distribution and therefore deserve special treatment in law.

In France, Germany, Austria, Switzerland, etc., any piece of woods on steep ground or otherwise peculiarly located may be declared "protective forest." This action on the part of these governments was not haphazard, it came after full consideration in which the best of European authorities had a hand. Europe as a people, and Europe as a government, believes in this forest influence; and has legislated accordingly and is willing to spend money and effort on the strength of this conviction.

Just as Mr. Moore neglects to discuss run-off in its true relations to forest so he deals with erosion as if it were a subject of no consideration. How observing Mr. Moore is on this point is well illustrated by the following on page 24: "In level countries it makes but little difference in this particular whether the ground is waste, cultivated, or densely forested, etc." We have here a veiled revival of the old, worn out "low gradient" argument which used to tell us that for instance, in the great lake countries erosion could not be serious. And yet right here in Michigan, Indiana and Ohio we have hardly a section of our rolling clay and loam lands where the farmer is not troubled by erosion. On thousands of acres it requires every year extra plowing to fill up gullies, and on thousands of acres more the gullies have become so deep and numerous as to ruin the land for agricultural purposes. On every line of railway out of Washington, D. C., Mr. Moore could see hundreds of gullies which have come there since the clearing of the land. How much more serious in mountain countries! That every bit of this erosion is injurious, that thousands of tons of fertile soil wash from the land even where no distinct gullies have as yet been formed, and that every rod of gully affects run-off and thus affects water storage, flood and drought, all this is not merely common observation but is capable of experimental proof such as was given by Wollny long ago. But Mr. Moore finds it cheaper and more effective to resurrect the "agricultural use" argument and puts in italics the following: "for the time is come—clear up the land, seed to wheat, corn, grass and fruits millions of acres that now lie idle under brush or forest."

The same evasion, the same substitution of political bosh for argument.

A similar unmeaning argument is put forth in the "ratio of forested area, or mountain watershed to the total watershed." Here the fundamental argument may be stated thus: Because only ten per cent of the entire watershed of the Ohio River is mountain country and subject to flood and erosion, therefore the Ohio floods are practically unaffected by what happens in these mountains, and, by inference, there is no need bothering about this unimportant ten per cent. The argument is a typical one, and is about as sound as if some one were to say that, because the people of New Orleans form only about one-third of one per cent of all the people of the United States it is entirely unnecessary and unwarranted for the federal government to concern itself with the floods or any other conditions affecting the people of that city. That these mountains cover in themselves millions of acres of land, contain thousands of people, that their streams affect millions of people more, that the floods pouring out of these mountains endanger life and property every year, and that every regulation we can give to these waters is of the greatest importance, all these things are carefully hidden by a lot of argument about moonshine. How exact Mr. Moore's data are is clearly shown by the following on page 34: "*According to our line of reasoning* which we believe to be fair and conservative *it is shown* that the average discharge of the Ohio River is not greater as the result of deforestation, etc." It is *the line of reasoning* which we are asked to accept for facts and then we are bluntly told in the conclu-

sions that floods are not more numerous, etc.

The entire paper is a jumble, it deals with a lot of irrelevant stuff crudely and poorly put together. It is full of fallacy and contradiction and is an insult to the thinking and observing people of our country. But it is even more. We have here an official of the United States Department of Agriculture going out of his way to oppose a most important piece of constructive and useful legislation, exerting himself to oppose the express wishes of millions of people, of dozens of prominent associations, of several state governments. And why all this? Is it because the law is a dangerous one, one that is likely to harm any person, any district? No, it is a simple effort at keeping a few million acres covered with woods to prevent the same millions of acres from becoming waste land. Then why does Mr. Moore exert himself? Are the reasons for this law so untrue in fact? Are there exact scientific data to prove them untrue? Evidently not, for if this "report" is any criterion, *it is evident that the belief of the people of the whole civilized world is based on observation, good sense and experience*, all of which seem sadly lacking in Mr. Moore's paper.

Then why does Mr. Moore do this?

* * *

FORESTS AS FACTORS IN STREAM FLOW

By L. C. GLENN, Professor of Geology in Vanderbilt University

IT HAS been the writer's good fortune to spend a number of seasons studying in the field the problems of denudation and erosion as presented in the Southern Appalachians and in the Monongahela river basin. As the result of this study certain conclusions have been reached as to the role forests play in the production of floods, the erosion of lands, and the silting of streams that are believed to be based on too great an amount and variety of direct field evidence to be successfully controverted. This investigation was undertaken to secure data bearing on the proposition to create a national forest reservation in the region examined. The examination showed that in many places conditions are already bad and are steadily becoming worse and that remedial measures need to be taken without delay, to protect the forests on steep slopes and to prevent erosion, silting, flood damages and interference with navigation. Because of the inter-state character of the streams involved, such remedial measures can only be taken by the federal government and several bills, the latest of which is the Weeks bill, have been introduced in Congress in the last few years seeking to remedy these conditions. Until recently the opponents of such federal action have had little or no material on which to base their opposition. Recently, however, several champions have appeared, the latest of whom is Prof. Willis L. Moore, chief of the Unied States Weather Bureau. A recent report by him on "The Influence of Forests on Climate and on Floods" is being widely circulated and used as an argument against the creation of these forest reserves, since the report is a denial that forests exert any beneficial influence on climate or floods.

This report of Professor Moore is too full of errors to be let pass unchallenged. Some of these errors are due to the statements made by Professor Moore being too broad and sweeping; some are due, either to Professor Moore's failure to grasp what the advocates of reforestation really propose to do, or to a failure on his part to make an adequate statement of their proposals; some are due to his confusing conditions on mountain head-waters with conditions on the lower navigable portions of river systems; some are due to a lack of information on his part of the actual conditions that prevail over thousands of square miles in the Southern Appalachians. Furthermore, a considerable portion of the report is not pertinent to the case in hand, so that when the non-pertinent and the erroneous portions are discarded there is but little left. So much for a general state-

ASBURY FRANCIS LEVER

Representative from the Seventh South Carolina District who has had charge of the Weeks bill in the Committee on Agriculture, from which it has just been favorably reported.

Mr. Lever was born at Springhill, Lexington County, South Carolina, January 5, 1875; graduated at Newberry College, 1899, and from the law department of Georgetown University, 1899, when he was admitted to the bar of his state. He was private secretary of Hon. J. William Stokes, whom he succeeded in Congress in 1900, upon Mr. Stokes's death. Mr. Lever was a member of the state legislature in 1900, resigning to make the run for Congress, to which he has been four times reelected.

ment as to the nature of the report. Let us examine it in some detail.

On the opening page he says, "It has frequently been stated that forests control the flow of streams, both in high-water stages and in low-water stages, * * *." This statement may be technically correct but is certainly misleading since it is not generally contended to-day that forests *control* but only that they *strongly influence* in a beneficial way the high and low water flow. If they *controlled* the flow presumably floods would be unknown.

Page 4 is misleading inasmuch as nobody proposes either to reforest or to keep forested lands that would subserve a higher usefulness as agricultural lands than they would as forest lands. The lands it is proposed to keep in forest are either those too rough to be of any agricultural value or those too steep to be cleared because of the danger of rapid erosion and ruin and the consequent destruction of lower lying lands and other property in the same drainage basin as well as to the streams themselves and navigation interests from silting and increased destruction due to floods. Lands so steep that under present careless methods of agriculture they are properly classed as forest lands may by improved cultural methods gradually come to be agricultural lands and so provide in the future for the time when population presses upon subsistence, but at present in the Southern Appalachians the people would be better off if they cultivated less land rather than more land. Professor Moore's phrase "the pleading of the poor man's children for bread and meat" used in the same connection on page 4 as an argument for further deforestation does not apply to conditions in the Appalachians and so is not pathetic, however well it may sound.

Nor would "homes and a well-fed people take the place of wild animals and the wilderness" as Professor Moore would lead one to suppose but rather a desolate waste would soon result, rain-scarred on the slopes and flood-swept in the valleys. Such destructive processes are actively at work to-day in these mountains and would only be made worse by adopting his proposals for further deforestation.

Near the bottom of page 4 the statement "It is found that *in some limited areas* where the forest is cleared away, the soil, owing to its nature and slope, will not admit of successful cultivation,"—(italics the present writer's)—is misleading. The writer would like to know how Professor Moore found that such areas are so limited. Personal examination shows that at least two-thirds and perhaps three-fourths of the southern mountain area will not admit of successful cultivation under present methods of agriculture and probably half of it could not be safely cultivated under any improved methods of farming likely to be introduced for years to come. The phrase "some limited areas" is therefore misleading in that it unduly minimises the extent of the non-agricultural area and tends to belittle the problem that demands solution. It would seem to be merely the personal opinion of its author and is not supported by the facts in the case.

On the top of page 5 it is admitted that such areas would be fit places for national control if it can be demonstrated that conditions there materially affect the navigability of streams. *An examination of the Tennessee made by the writer does show that much material eroded from the steep mountain slopes is accumulating in the navigable reaches of that river and is injuriously affecting navigation. This material tends to fill the deeper pools, to lodge on the shallow bars, to obliterate dredged channels, and to aid in the growth of islands, the displacement of the channel, and the undercutting and caving of the banks.*

Pages 5 to 15 discuss the effects of forests on climate particularly with regard to their influence on rainfall and on temperature. So far as the writer knows no one is claiming that there has been any such serious change in the rainfall or in the temperature in either the Northern or the Southern Appalachians as a result of deforestation, as

to base on such change any important argument for congressional action. The pages devoted by Professor Moore to such discussion are not pertinent to the case at all.

In discussing the influence of forests on floods in the latter half of his paper Professor Moore fails to distinguish between the characteristics of the many non-navigable head-water tributary streams and those of the main navigable stream. It should be kept clearly in mind that the steep mountain basins of these head-water tributaries are the areas where reforestation is advocated because they are the areas of greatest erosion and greatest flood damage. The marked increase in the frequency, height and violence of floods in recent years in the Southern Appalachians has been on these head-water tributaries such as the Doe, the Watauga, the Nolichucky and the French Broad, for instance, of the Tennessee system and not in the lower Tennessee itself. In March, 1907, for instance, the remarkably destructive flood in the Ohio river system was at and above Pittsburg, not down at Cincinnati, Louisville, or Cairo. On the Savannah, the Broad, the Catawba, and all other large rivers heading in the Southern Appalachian mountains the locus of maximum flood violence and destruction is near where they, or their head-water components, first leave the mountains, not far out on the plains along their middle and lower reaches. Professor Moore confuses these two portions. Instead of focusing his attention on the navigable middle and lower parts of a river system like the Tennessee, he should become acquainted with the upper or head-water part. Colonel Chittenden and other army engineers fall into the same error. The navigable portion of any large river system does not exhibit such marked change of regimen as a result of deforestation as its constituent head-water tributaries do. Each of these tributary basins is small enough to be affected throughout its entire extent by unusual weather conditions and the tendency in such basins is toward an *extreme* condition while the tendency in the trunk stream formed by the union of many of these tributaries is to a *mean* of the conditions, either high or low, that characterize the tributaries. Profound changes in the high and low water stages of certain mountain head-water tributaries might occur without producing any strongly marked change of regimen in the middle and lower reaches of the trunk stream. A flood on the Watauga, for instance, five feet higher than any ever previously known and utterly destructive of all property within its reach might not add a couple of inches to the stage of the Tennessee at Chattanooga or be perceptible at Paducah. Professor Moore and others are either ignorant of the locus of maximum flood damage or confuse it in their reasoning with conditions in the middle and lower part of the stream basin where such extremes do not occur. Most of their arguments apply to these lower reaches. It is believed by the present writer that a very general change of regimen on the head-waters will be reflected in a corresponding mean change in the high and low water stages in the main trunk stream in any large river system but this mean change will be far less striking on the trunk stream. It should be remembered, however, that so far as the navigable middle and lower parts of a large river system are concerned the amelioration of flood and drought conditions is not the only, and may not in a given case be the chief, effect, but that the prevention of erosion of steep slopes and the consequent serious silting of the navigable portions of the streams will also be a most important effect of reforestation.

In discussing run-off and absorption on page 16 it is not sufficient for Professor Moore to say that "it can be shown that the run-off from a smooth surface and from one covered with sticks, dense grasses, or forests are *cqual* (italics mine) after the rough surface becomes saturated." They may be ultimately *equal* in total volume of run-off but still be far from equal in

Sand Deposited on Alluvial Bottoms by Freshets, 1901, Catawba County, North Carolina

rapidity of run-off and it is the *rapidity* of run-off that counts in flood production. It is a matter of elementary physics, merely, to show that the rapidity or velocity of run-off from a rough surface such as a forest covered one would not be as great as from a smooth one of the same slope, whether the subsurface were saturated or not.

The writer feels very certain from his field studies that the absorptive capacity of the average Southern Appalachian forest area is very materially greater than the absorptive capacity of the average cleared field in the same region, and this balance in absorptive capacity in favor of the forest is a potent factor in preventing or mitigating flood disasters. Up to a certain maximum limit of rainfall that would vary in each individual case, the forest cover would prevent any run-off at all; if the rainfall be doubled the forest cover would retain half of it; if quadrupled a fourth; and if in torrential downpours it retained only a tenth, say, of the rain that fell, it is still just so far beneficial in its influence and without it the resulting flood would be just so much the worse. It is illogical to conclude that the forest has no beneficial influence merely because it fails to control floods entirely, and it is in the very worst floods that any ameliorating influence is most needed. It may be remarked that the writer knows no kind of vegetation on cleared land in the Appalachians that exerts anything like as great a conserving influence on the rainfall as the forest does, simply because the covering of humus and litter in the forest is both thicker and a more efficient absorptive agent than any vegetable cover on the cleared land.

In regard to the quotation from the French engineer, Mr. St. Clair, on page

18, it might be of interest to Professor Moore to learn that of the two types of springs there described,—the small or superficial ones, drawing their supplies from the strata very near where they issue and the large or deeply subterranean ones drawing theirs from long distances and large areas as in limestone regions—only the first or local type of springs is found, except in a few rare cases such as at Warm Springs in North Carolina, in all the Southern Appalachian region and Professor Moore's French author admits the increased irregularity of flow and even the drying up and entire disappearance of such small springs as a result of cutting away the forests. This is exactly in accordance with what is found in the field in the South and had Professor Moore known the actual conditions in the region about which he was writing he probably would have omitted this quotation.

Several pages are devoted by Professor Moore to discussing the academic question of the source of flood waters in the United States. Whatever the source of these waters no one has yet proposed to alter or change in any way the general system of atmospheric circulation over the country at large and until this is successfully done the rains will continue to come from the same sources as of yore. *It is not a question of where the rains come from, but what we are going to do with them—or they with us—after they have gotten here.*

Erosion is handled very briefly and lightly by Professor Moore and no very definite conclusion or conviction as to it is expressed. Erosion is, however, one of the most powerful destructive agencies at work in the mountain region and is of supreme importance in any study of the relationship between forests and streams. There is not room here for any detailed discussion of erosion but it will be referred to again in discussing the question whether floods are increasing or not.

In discussing the ratio of the forested area, or mountain watersheds, to the total watershed there is the same failure to appreciate the differences between these mountain watersheds and the rolling or level plain portion of the great stream systems that has been noted already.

The flood problem so far as the lower, more nearly level lands is concerned, is not a forestry problem but an agricultural one and nobody is proposing to consider it as a forestry problem.

On page 25 Professor Moore italicises two consecutive sentences, each of which demands some brief comment. They are as follows "*The rugged mountain slopes and tops, where land has little value, are unimportant as flood producers. It will be necessary actually to reforest the lower slopes and valleys where the land is of great value and where it should be devoted to agricultural purposes.*" In the first of these sentences there is, apparently, the former confusion of linking steep mountain slope causative factors directly with mid and lower main stream flood results and there is at the same time apparently a total ignorance of the perfectly evident fact that these rugged slopes are most important flood producers in such large tributary basins as the Watauga, the French Broad, the Pigeon and the Little Tennessee, all of which lie among the mountains themselves. With regard to the second sentence above quoted one wonders if there has been a slip of the pen or if, despite all of his arguments to the contrary, its author really means to say that forests do after all exert an efficient regulative influence on flood production.

The last topic discussed is whether floods are increasing. Here again Professor Moore has in mind floods on the lower, navigable portions of stream systems. His argument and array of statistics, when balanced against Mr. Leighton's opposing ones, are at most not convincing. The present writer, however, has studied in the field certain processes that are of such widespread occurrence and distinctive character as to leave no doubt that floods are increasing both in frequency and in height. These processes have to do with erosion as the chief causative factor and a very brief statement concerning them becomes necessary.

ON THE TENNESSEE RIVER, NORTH CAROLINA

Pines that sprung up in this badly gullied pasture were cut out. They would have checked the wash

Under natural forested conditions streams in steep-sloped mountain basins receive comparatively little eroded material from their slopes and expend much of their energy in eroding their beds and so soon produce good deep channels that are efficient agents for the rapid removal of flood waters. Such deep stream channels may be seen in any well forested region. When the steep slopes have been denuded of their timber, however, they are rapidly attacked by erosion and the soil and disintegrated rock are swept into the stream channels in such great quantities as to overload and choke the streams and soon fill up their deep channels and even cover up their former flood surface. With their deep channels obliterated, the streams can no longer remove rainfall efficiently and rapidly and it consequently accumulates and rises to greater heights than formerly. Futhermore, many a small rain that, with the former deep channel well fitted for the rapid removal of flood waters, would have failed to make a bank-full stage, now overfills the greatly shallowed channel and spreads as a flood over the adjacent lands, so that there can be no doubt that in the denuded and eroded mountain basins of the size of the French Broad or the Nolichucky, for instance—each of which are good sized rivers—floods are to-day both higher and more frequent than they formerly were under natural forested conditions.

The problem of whether floods have increased in height and violence in recent years may be approached from another and in many respects a more certain and satisfactory viewpoint than either that just given or that of the meteorologist dependent on his gage readings. This third viewpoint is that of the geologist and physiographer, and

its superiority consists in the great length and permanence of the record and in the unmistakable character of the data it furnishes to one skilled in reading such a record.

The meteorologist depends on gage readings of flood heights, made by man and often incomplete, the best of which in this country extend back for only a few score years and in Europe for only a few hundred years. The geologist depends upon records thousands of years in length made during all the long ages in which the valley and the flood plain were forming and written in the materials of the flood plain and in the width, slopes, and other features of the valley. Beside these records the length of even the longest meteorological gage records becomes insignificant.

The flood plain deposits that have been built up by the ages of slow flood activity reveal the character of the floods by which they were formed. If these have been gentle, the deposits will consist of fine alluvium; if they have been violent, the deposits in a region such as the Southern Appalachians, will be correspondingly coarser and will consist of sands, cobbles, or boulders. If the sands, cobbles, and boulders that have been repeatedly strewn over their floodplains in the last few years by such streams as the Watauga, the Doe, the Nolichucky, the Catawba, and other southern rivers had been the kind of material these rivers had for ages been accustomed to deposit, their entire flood plains would be composed of such coarse materials instead of being, as they are, of fine rich sandy loam or clay. Had they at any time in their past history been accustomed to build such coarse material into their floodplains that material would be there to-day as a mute witness of the fact. It is only of recent years, however, that they have formed such coarse deposits because only in recent years have their floods had the height, velocity, and power to enable them to carry such coarse materials. The normal change in the regimen of a river as the ages pass is such as to make its flood plain deposits grow constantly finer. In these rivers, however, this process is reversed and thin deposits have recently grown coarser. This recent anomalous change in the regimen of these rivers can only be due to the denudation and erosion that have resulted from man's activities in the region. *The rivers of the region have recently changed their regimen and floods have become higher and more violent, else sands, cobbles, and boulders would not have been strewn during the past decade over the finer alluvial accumulations of many previous centuries.*

Finally, to say as Professor Moore does in his summary, that the run-off is not materially affected by any other factor than precipitation is ridiculous.

"THE INFLUENCE OF FORESTS ON CLIMATE AND ON FLOODS"

A Review of Prof. Willis L. Moore's Report

By GEORGE F. SWAIN, LL.D.
Professor of Civil Engineering, Harvard University

IT MAY be well to preface this discussion by a brief reference to the proper methods of scientific investigation, because these are often forgotten, even by those who lay claim to scientific acquirements, and because it will be shown in what follows that in the paper under consideration such has been the case.

In the investigation of scientific phenomena two methods alone may be employed: The inductive and the deductive.

If the relations between two phenomena are to be studied by the inductive method, the process is to collect observations, or to make experiments, in which one of these phenomena is varied, while the effects upon the other are observed. The method consists in accumulating a sufficient number of such observations and experiments, and from them drawing generalizations. It is a statistical method—a reasoning from particulars to general principles.

In the deductive method the process is reversed; starting from general principles all conclusions are deduced from

Southern Appalachian Mountain Field Ruined by Erosion

them; the reasoning is from general principles to particulars. Omitting metaphysical subtleties, it may be said that the general principles which form the starting points may be obtained in either of two ways: they may be truths which the mind perceives or arrives at without experiment or observation, such as the fundamental truths of mathematics and mechanics; or they may be truths which themselves have been arrived at by induction and which are then used as the basis of deductions.

Some minds instinctively prefer one of these methods, some prefer the other. Some people are only satisfied by statistical proof, or what appears to be such. I presume some people would require a statistical proof of a future life; they would desire to have records of interviews with departed spirits, to know how many of such departed spirits said they were alive, and how many said they were dead, and whether the proportion of those who said they were alive had increased in recent years. Some minds, on the other hand, seem almost incapable of inductive reasoning. They must start with fundamental principles and reason from them, and if they have no fundamental principles to start with, they will create them from their own imaginations.

Clearly, a proper combination of both methods, using each where it is applicable, is the basis of reasonable scientific investigation.

DIFFICULTIES WITH THE INDUCTIVE METHOD

There are several serious difficulties which are likely to be encountered in the application of the inductive method, and many precautions which must be taken if error is to be avoided.

In the first place, a very essential point to be observed is, that in order to determine the effect upon Phenomenon B which is exerted by Phenomenon A, the observations or experiments must be so conducted that, of all the elements which may effect B, all remain constant excepting A. In other words, only one

phenomenon at a time must be varied. If the physician wishes to determine whether mince pie is a cause of indigestion, he will not give his patient, at the same time, mince pie, lobster salad and Welsh rarebit, for, if he does and indigestion results, he cannot fairly attribute it to the mince pie. If a metallurgist wishes to determine the effect of various percentages of carbon upon the strength of steel, he must be very careful to procure a number of samples of steel precisely alike in every respect, except that the percentage of carbon varies; and it will not do, in such a case, to say that because there is only a *slight* difference in the percentage of some other element, such as nickel, the experiments prove the effect of the carbon, because it may be that an extremely small variation in nickel would have more effect than a large variation in carbon. Only one element must be varied at a time, and this is an extremely important consideration.

A second difficulty arises with the inductive method if the observations vary very greatly from each other. If, for instance, it is desired to find the effect of Phenomenon A upon Phenomenon B, and if this effect in any case is small, while Phenomenon B, is exceedingly variable, it may be difficult to show by statistics that Phenomenon A has any effect at all, though that effect may be unquestionable. There are other matters affecting the general methods of scientific investigation which are suggested by this paper, but they will be taken up in connection with the specific points in Professor Moore's paper which illustrates them.

EFFECTS OF FORESTS ON RAINFALL

Fourteen pages out of thirty-six in Professor Moore's paper are devoted to a discussion of the relation between forests and rainfall.

This relation is of no consequence so far as concerns the Weeks bill, or the claims made by those who believe that the government should acquire forest reserves. No one has insisted, so far as I know, that forests have any considerable effect upon rainfall. Mr. Pinchot in his "Primer of Forestry" states that no generally accepted result has yet been reached in the matter; that the observations are not all in agreement, and concludes by saying: "The truth probably is that more rain falls over the forests than over open country similarly placed, but how much more it is impossible to say." Professor Moore deals with this subject as though it were one of the most important involved. He quotes from several authors with reference to desiccation in other countries, where the rainfall, once abundant, has become much less or disappeared entirely, and says that "this decrease or precipitation might better be regarded as the cause rather than as the result of the barren condition of the soil" * * * "that the forests ceased to exist when the rainfall became deficient;" and he seems to think that this proves that forests do not increase the rainfall. He compares the rainfall records in New England and in the Ohio Valley for the past seventy years and concludes that it is not decreasing. His conclusion on this point is stated in the following paragraph:

"In New England, where deforestation began early in our history and has been extensive, the mean of the fluctuations of the rain-curve is a steady rise since 1836 up to a few years ago, and in the Ohio Valley, where the forest area has been greatly diminished, there has been no decrease of rainfall shown by the average of the fluctuations of the curve. These facts are important and cannot be successfully disputed."

A careful examination of Professor Moore's statements will show that they offer no proof whatever that forests do not affect precipitation. It is admitted that climatic and geologic changes are taking place very slowly at many places on the earth; mountain ranges are being elevated, other districts are subsiding, ocean currents are changing, and in the course of thousands of years variations in climate, including temperature and rainfall, result. Undoubtedly forests have disappeared in many places because the rainfall has been diminished;

but that does not prove that the forests may not increase the rainfall; a man ceases to drink water after he dies, but that does not prove that the drinking of water has no relation to keeping him alive. There may be; and no doubt is, a reciprocal relation between the forests and the rainfall. If the rainfall disappears the forests, of course, will die, and great climatic changes may make the rainfall disappear; but, all the same, the forests may increase the rainfall.

VIRGIN SPRUCE IN WHITE MOUNTAINS
But little of this once typical forest remains

As a matter of fact, this subject affords an excellent illustration of the imperfections of inductive reasoning in this case. The rainfall is an exceedingly variable quantity; the annual rainfall this year may be double what it was last year. Even taking the average in ten-year periods, Professor Moore's curve for New Bedford shows an average of about forty-nine and a half inches in the ten years from 1820 to 1829, and forty-three and one half inches in the ten years from 1840 to 1849. In 1883 the rainfall near Boston was thirty-one and two-tenths inches; in 1888 it was fifty-six and ninety-three one-hundredths inches; in 1892 it was thirty-nine and four one-hundredths inches. Moreover, these observations of rainfall themselves are subject to large errors. A rain-gauge whose mouth stands one foot above the ground may collect six per cent more water than if it were placed level with the ground, and if placed higher the difference may be still greater; moreover, the methods used for measuring the snowfall and reducing it to inches of water involves errors, and there are still other sources of uncertainty. Considering that, even if the forests are untouched, the rainfall over a given area may vary fifty per cent or more in consecutive years, how can it be expected to demonstrate by a comparatively few years of observations the effect of the forests—which, in any case, will be small? Any effect of the forest would very likely be less than the probable error of the observations themselves. Under these conditions, therefore, the inductive or statistical method fails. What then, are we justified in doing?

Professor Moore draws this conclusion: "Precipitation controls forestation, but forestation has little or no effect

upon precipitation." He further makes "a plea for tolerance of opinion" and, presumably in connection with this plea, quotes the very intolerant opinion of Prof. Cleveland Abbe: "In this day and generation the idea that forests either increase or diminish the quantity of rain that falls from the clouds, is not worthy to be entertained by rational, intelligent men." If he were presenting a fair and a scientific discussion, recognizing that the inductive or statistical method will not give definite results, he would see that we must resort to the deductive method, provided we can find some fundamental principles, reasonably established, upon which to base our deductions. He recognizes, indeed, that the statistical method will not work for he says: (page 16) "All of these problems could be definitely settled beyond the possibility of argument if we had accurate river gaugings from day to day and from year to year, together with a full knowledge of the rainfall and of the proportion of wooded to cleared areas, data which, unfortunately, we do not have." But, he goes on to say, incorrectly, that we must, therefore, "reason empirically from the best information at hand." Empirical reasoning will scarcely lead to reliable results.

Now as a matter of fact, there are several well established principles which bear upon this matter, and which give very good *a priori* reasons for believing that forests do slightly increase the rainfall. The first of these Mr. Moore mentions (page 22) quoting from Prof. Bailey Willis:

"The mountains are wet because they are high, and they are heavily forested because they are wet. But there is also a reciprocal action of the forests on the wetness, for the radiation from the dark-green expanse is comparatively uniform and promotes frequent and steady rains. Were the mountains bare they would, like the bared sierras of Spain, receive occasional but violent downpours and send down excessive and disastrous floods, even more disastrous than now. * * * For in-so-far as we clothe the surface with green crops we lower the temperature of the rising air and favor precipitation on the verdure-covered plain."

Regarding this statement by Professor Willis he goes on to say "It would be difficult to either confirm or disprove this statement of Mr. Willis." If this is the case, why does he draw the conclusion that forests have no effect? It would be fairer, as well as more logical, to simply say, what is the truth, that many competent meteorologists believe that forests increase the rainfall, that there are good theoretical grounds in favor of it, but that the effect is slight, and difficult if not impossible to prove by observations, considering the variability of the phenomenon.

It is a reasonably established fact that forests decrease the mean annual temperature. This has been proved by many observations. They therefore bring the air nearer to the point of saturation, and therefore tend to increase the rainfall. Professor Moore argues that this effect amounts to nothing because "the rain is precipitated largely from air masses that exist at a considerable distance from the surface of the earth." The height above the ground at which vapor is condensed in the air is variable; it may be at a great height or it may be close to the ground. On mountain sides, particularly, the condensation may occur at, or even below, the level of the forest. We all have seen rain falling from clouds lying at a height considerably below the tops of mountains or even high hills. Any effect of the lowering of the temperature produced by forests, therefore, will be particularly noticeable in mountainous regions. Just how much the effect will be will depend upon various circumstances; among others, the distribution of the rainfall through the year, for the effect of forests on temperature differs in summer and winter; but with a rainfall distributed with tolerable uniformity through the seasons, the resultant effect should be to increase—even if but slightly—the amount of rainfall.

A second principle from which we

may proceed in this matter, is the effect of forests on evaporation. By cooling the air and obstructing the wind, forests reduce the evaporation from a water surface, but the trees themselves evaporate considerable quantities of moisture, so that the total evaporation over a wooded area is generally considered to be greater than over a cleared area. Those who oppose the preservation of the forests sometimes make a great point of this. Now, the precipitation of rain depends fundamentally upon the amount of vapor in the atmosphere; most of this vapor comes from the great oceans and is carried by the winds over the lands; but if, as it proceeds over the land it is joined by more vapor evaporated from the land itself, there will be all the more vapor in the atmosphere to be condensed when the conditions which produce condensation occur. Any cause, therefore, which increases the evaporation must increase the rainfall; and if—as there is good reason to believe—the growth of forests increases the total evaporation from an area, it would seem they must increase the rainfall.

This does not mean that if I planted trees in my back yard I will increase the rainfall in my backyard; neither does it mean that if forests are planted on a spit of land projecting into the sea like Cape Cod, the rainfall on Cape Cod will be increased. The vapor is not precipitated where it is evaporated, but is carried long distances; some of it may be precipitated on the land and some on the sea. Generally speaking, however, the argument would seem to be sound; that is, if forests increase evaporation they must increase the rainfall somewhere.

All this, however, is of little consequence as compared with the larger question, and the main question, as to the effect of forests upon floods and the navigability of streams. It must also be remembered that those who are in favor of the Weeks bill do not argue, as Professor Moore would seem to make it appear, that the forests must be preserved on areas suitable for cultivation and needed for cultivation. "The pleading of the poor man's children for bread and meat" referred to by Professor Moore, is a sentimental obscuring of the question. What is claimed is that on the steep slopes and mountain sides which are not suited for agriculture, the forests should be preserved, not only as a source of lumber supply but as a protection against the fires which are most apt to start on the cleared lands, and as a protection to navigation by preventing erosion and the silting up of streams, and also as a source of beauty and health; but the legal justification must, as already stated, rest solely on the effect upon navigation.

EFFECT OF FORESTS UPON FLOODS

In studying the effect of forests upon floods by the statistical or inductive method, we meet with even greater difficulties than in studying the effect upon rainfall. One of the most important of these difficulties arises from the fact *that we cannot vary only one element at a time*. Not only is the rainfall different in different years on a given area, but the proportion of that rainfall which flows in the streams, even if the rainfall is precisely the same, may vary in different years by 100 per cent. In 1871 the rainfall on the Cochituate watershed was forty-five and thirty-nine one-hundredths inches, of which thirty-three per cent flowed from the surface, the remainder being either evaporated or sinking into the deep strata; while in 1891 the rainfall was almost exactly the same, namely forty-six and forty-two one-hundredths inches, of which sixty-nine per cent flowed from the surface; in 1874 the rainfall was thirty-five and ninety-three one-hundredths inches, of which fifty-four per cent was collected; in 1880 the rainfall was thirty-five and eighty-three one-hundredths inches, of which only twenty-nine per cent was collected. Equal variation occurs in the manner in which this water flows off; a large amount may flow off without causing a flood, or a smaller amount may flow off causing a great flood. Now, in order to demonstrate by induction the effect of forests on floods,

it would be necessary to have the same area under identical conditions except that at one time it should be forested and at another time it should be deforested; this condition is manifestly impossible of attainment; it never has been attained and it never will be. In the published comparisons which are found in various papers dealing with the subject, the conditions are never the same. A curious fact, however, is that Professor Moore and some other writers should not think it even necessary to make any statement as to the proportion of given area under discussion which is covered by forests. Professor Moore thinks he shows that the floods in the Ohio River have not increased, but he does not even tell us and does not seem to think it necessary to inquire whether the total forested area has increased or decreased and how much. He reasons entirely from one premise. He says: "The floods have not increased, I do not know definitely about the forests, therefore the forests have no effect on floods."

Now while there has been great cutting on the mountain slopes during the past decade or two, it is very possible that some other slopes which had been cut previously have been growing up, and the total forested area may have changed but little. Certainly no conclusion worthy of credence can be drawn until this point is investigated.

Statistical reasoning, therefore, is unsatisfactory in this case as it is in connection with rainfall, and we must therefore resort to deductive reasoning based on simple fundamental principles; and here again there are two principles which every observing man knows to be true and which no amount of specious reasoning like that of Professor Moore will suffice to counteract.

These are, first, that the forest retards the discharge of water from the surface of the ground. The forest causes a million dams, which obstruct the surface water and cause it to trickle along slowly; it also forms a bed of humus which is able to absorb this water; beneath which is a porous ground which can carry it still deeper. When a sudden downpour comes, not only do the forest trees intercept a portion of rain on their leaves and branches and allow it to trickle gradually down the trunk or drip to the ground, but the water, when it reaches the ground, is obstructed and has time to sink in, and finds something to sink into. On the open ground, on the contrary, on steep slopes (and it is only these that we refer to) a sudden downpour causes the water to be discharged quickly over the surface into the streams. If the forest then, as every reasonable man knows is the case, retards the surface run-off, it must, on the whole, diminish the violence of freshets.

The second fact of importance is that the forest retards the melting of the snow; everybody familiar with the country knows that in the forest the snow lasts considerably longer than it does in the open, although there may be isolated drifts in the open where certain beds of snow may linger longer than the snow in the forest. On the whole, and speaking generally, forests retard the melting of snow, and therefore every reasonable man will conclude that they must, on the whole, by causing the snows to be discharged in a longer time into the streams, reduce on the average, the floods. Moreover, by facilitating the percolation into the ground and the subsequent slow giving out of the percolated water by springs and seepage, the forests must, on the whole, maintain a higher low-water flow in the streams.

Professor Moore's arguments on this point—if they may be called arguments—are in part faulty and in part based on a misconception of the question, as will now be shown.

In the first place, the sum and substance of his claim is that forests do not decrease the *extreme* floods or increase the *extreme* low-water flow. This has long been admitted by competent hydrologists. It is even possible to conceive circumstances under which the presence of a forest might increase the flood which, if the forest were not there, would come from a given area. But the navigability of streams, the forma-

tion of bars, the silting up of channels, do not depend upon extreme conditions. Three or four moderate floods may do as much damage to a navigable river as one extreme flood, and may bring down more sediment to be deposited in the river bed. Professor Moore's authorities in this particular discussion are Prof. Cleveland Abbe and two French engineers, M. Belgrand and M. Vallés, both of whom wrote their original discussions on this subject over fifty years ago. To his quotation from Professor Abbe we need pay little attention, as it has reference to level ground, whereas we are discussing the effect of forests on steep slopes. Ploughed and cultivated land is very likely quite as porous and quite as able to absorb rainwater as forest ground, as Professor Abbe says. It is quite easy to understand, however, how he can make out that "under a forest less rain *actually enters the humus*," and yet goes on to say "that the amount of water that is eventually *given up from the forest humus* varies but little from that given up in the course of time by the unforested cultivated soil." Less rain enters the humus but essentially the same is given up from it.

With reference to the French writers, Belgrand and Vallés give exactly the same arguments that are advanced by Professor Moore, and by Colonel Chittenden in his recent paper to which the present author published a reply a few months ago. A sample of M. Vallés' reasoning may be quoted to show the kind of logic which appeals to his mind. He says that the forest ground is less porous than bare ground because if you should ask a laborer in which he would prefer to dig a hole he will select the latter. He might as well argue that an acre covered to a depth of ten feet with a mattress of barbed wire was less porous than hardpan for the same reason. As a matter of fact, both of these authors entirely agree with the position taken by the present writer and by those who urge the passage of the Weeks bill, that forests should be maintained on steep slopes which are unsuitable for cultivation. Belgrand says:

"The operation of reforestation is thus excellent when practically possible, although it seems demonstrated that the deforestation of the basin of the Seine cannot be considered one of the causes which contributed to increase or to decrease the height and the number of floods. *But the forests diminish very notably the volume of earthy matter transported by the streams, because they prevent the erosion of the earth, and, it must be recognized that the impoverishment of the earth is much more to be deplored than the disasters caused by floods.*"

M. Vallés says: "If the demand is limited to the reforestation of the summits and uncultivated slopes, we wish well of it, but less from the point of view of diminishing the quantity of water discharged than from that of preventing the erosion of the earth, particularly if a study is made of reforestation in itself, which shall indicate to us, first, in what circumstances it can be realized, and in the second place, under what conditions it will be useful at the same time to private interests, and will be for the general good. If it is thus that we are to understand the advocates of this system, we do not hesitate to join with them; but if their demands are more extended, if they wish us to reestablish on ancient foundations a condition of things which has been usefully modified, if they desire that we should prefer the Druidical forests to our modern farms, the trees to the corn, the corn to the grain, we say to them for the third time: reforestation will not do."

Bearing in mind that Professor Moore's argument was written as a contribution to the discussion involved in the Weeks bill, it would be interesting to inquire why he did not quote these two passages, if he knew them. If he did not know of them he should not discuss the subject and give the erroneous impression that these authors denied the necessity of preserving the mountain forests.

Equally misleading is Professor Moore's quotation from the Austrian engineer, Mr. Ernest Lauda (page 19) and the conclusions of the Tenth Inter-

national Congress of Navigation held at Milan in 1905. Professor Moore says that Mr. Lauda's conclusions are "that progressive deforestation of the country has had no effect in increasing floods nor in augmenting their height." Let us read Mr. Lauda's conclusions as presented at the Congress in Milan. He says:* "If now the final judgment on the subject of the influence of forests on the regimen of streams be unfavorable to the forest to this extent, that there are denied to it certain of the properties attributed to it generally, it does not follow from this that it is necessary to oppose the re-wooding of arid surfaces, the replanting of the basins of streams, or the maintenance of plantations of trees. The general utility of the forest is so well settled, the extraordinary appreciation in which it is held, *as a means of protecting the soil against landslides,* is so firmly established, its great advantageousness, especially for the spring district, in holding back earth thrusts and *reducing the amount of sediment carried by rivers* so important, *that these reasons alone justify fully the greatest possible promotion of forest culture.*"

Any fair discussion would have included this reference.

Professor Moore, referring to this Congress says: "The writers heartily favor the protection of the forests and their cultivation" but "they were unanimous in the opinion that forests exercise little influence upon either the high water or the low water of rivers.

Let us now quote from Cipolletti's review of the conclusions of this congress. He says:*

> The other part of the question, concerning the influence of forests upon surface waters, is perhaps the most important of all and to all; and it is, no doubt, the one upon which our authors' opinions differ most. One may state, that they all recognize, or at least none denies, the beneficial influence of forests upon the regimen of a river in its state of low-water flow, high-water flow, and ordinary floods; but many of the writers, we may say the majority of them, deny that forests have any power not only of preventing, but even of mitigating to any appreciable extent the more serious and damaging floods, which occur in every country at certain periods.

*This translation is not mine.

The low-water flow—as is commonly known—depends almost exclusively on springs; and having once admitted the fact, that a covering of trees exerts a beneficial influence upon the flow of springs, we may at once draw from it the legitimate conclusion, that the regimen of low-water flow of a river is favourably affected by the existence of forests in its basin; except, be it well understood, the cases already alluded to, of an extremely permeable soil or of lands which can be cultivated without the loss of the humus covering, cases in which, as has already been stated, it is possible that deforestation may help the absorption of the water into subsoil and thereby increase the volume of the low-water flow in the general recipients, the rivers.

But with regard to the regimen of high-water flow and ordinary floods, there is no material difference of opinion. In such localities the waters running off the surface unite with the springs in providing the supply of water for a river. Thus, all the writers agree that forests exert a moderating influence on the run-off of surface waters, owing to a large proportion of the water being retained by the leaves and other parts of the plants, also on account of the quantity of it being absorbed by the layers of dead leaves, moss and humus which form the top covering of the forest ground, and partly also to the obstruction which roots above ground form to the rapid flow-off of the surface water, by forcing it to remain stagnant in a thin sheet, instead of accumulating in a mass and running off quickly in the shape of brooks, which is what happens where the surface water finds little obstruction and is apt to produce erosion. To this may be added, in the case of cold climates, the additional advantage that the snow lies longer in the forest and melts here more slowly than in the open country. To conclude, forests act as real regulators, obliging the rain water to flow much more slowly to the bottom of the valley, than it would do otherwise, and by this means ensuring a more uniform and continuous flow in the lower reaches of rivers.

But, as already stated, opinions differ widely the moment we approach the subject of phenomena which are apt to produce heavy and extraordinary floods. Some of the authors (Messrs. Ponti, Keller, and Wolfschutz) assert with insistence that heavy floods are due entirely to climacteric causes and that, consequently, the influence of forests is nil, or at any rate so small, that it can be neglected altogether. The reasoning by which they arrive at this conclusion is as follows: These great and extraordinary floods, they assert, only occur after downpours lasting several days; hence, under similar circumstances, we must take it for granted that the leaves and all other parts of the plants have already soaked up the maximum quantity of water they are able to retain, that the upper layer of the soil

is completely saturated and that the surface waters have already reached the bottom of the valley, when it is still raining in the more elevated and more distant parts of the catchment area. Under these circumstances, they maintain, the volume of water which comes down as rain is equal to the volume of water which flows to the bottom of the valley in the same time; in other words, the moderating influence of forests—like that of lakes and every other agency of this kind—tends to fall off with increasing length of time, while the phenomena lasts until finally a point is reached when the efficiency becomes nil. Such is the fundamental argument of all these writers, and it does not appear to us that anybody has given them as yet a pertinent reply. Although I am only a reporter, I may be allowed to interpose in the question, because it does not appear to me that things happen exactly as they might appear. In the first place, I may remark that in order to arrive at such a necessary state of equilibrium, it is not enough, that the phenomenon should last for a sufficiently long period of time, but it is also necessary that the intensity of the phenomenon should also remain uniform during the whole period. Everybody will see, how during the same period partial compensation will take place, the outcome of which will be a tendency toward the average value of intensity, with an elimination of the greatest crises, which in itself is already a no mean advantage; but there is still more than this. By admitting that in consequence of the prolongation of the rain, a moment is at last reached when there is as much water coming down into the valley as there is coming down higher up in the catchment area in the form of rain, it still has to be proved—and, as a rule, this does not happen—that this state of equilibrium coincides exactly with the moment of the greatest intensity. In every instance in which I had to study phenomena of this kind in respect of lakes and floodings of valleys, I found that this period of equilibrium was reached invariably when the rain was abating, that is, when a falling off had already taken place in the intensity of the phenomena; in other words, that the phenomenon had reached its maximum degree of intensity before the moderating power had become exhausted, the latter having thus already made its beneficial influence felt at the most critical period.

If we next proceed to studying the question by the light of recorded facts, doubts arise and difficulties are met with, which are perhaps not less serious.

The advocates of the two opposite views have endeavored, by means of minute and most laborious researches, to get an insight into the past and to see whether it was possible or not to discover any difference in the regimen of great rivers for the past century, a period from which, generally, dates the deforestation carried out on a large scale in Europe; but they always found themselves face to face with very serious difficulties, to which I will only allude briefly.

All records which refer to great floods in past centuries are always surrounded by so many uncertainties and doubts, that it is most difficult—not to say impossible—to draw any certain and indisputable conclusions therefrom. We have a striking example of this in the Tiber—a river after which the Nile is certainly the most historical of all—in the case of which it has been so far impossible to ascertain if its floods have undergone any change in the course of centuries.

Can the destruction of forests bring about a great deterioration and even the total loss of the layer of cultivated soil of cultivated lands, of those which are next to them, or lying beneath them, and, even further off, of the level portions of large valleys? Can it also cause landslips, landslides, and avalanches?

Upon this point it will be very much more easy for me to arrive at a conclusion *because the authors of the papers, without distinction, and all technical experts generally admit that the deforestation of sloping lands, especially if it is followed by a breaking up and cultivation of the soil, will cause the damages and injuries enumerated at the head of this chapter.*

Otherwise, it is easy to understand, and we are all daily witnesses of it, that when land with a sufficiently steep slope is deprived of the protection which roots of trees offer against erosion, and still worse, when the soil is subsequently broken up with plough or spade, the water, being able to flow off more quickly and to collect on a surface which offers but little resistance, can very easily remove and carry away with it to the bottom the earthy materials which form the cover, and leave the land denuded and barren. One can also easily understand that brooks, formed in this manner, can produce similar effects as regards laying bare the top of the slopes and carrying the material to the bottom of the incline, a place where the ground is better situated; and that the deep gullies, which similar small but impetuous, torrents scour upon the slopes of mountains and hills, can in their turn also cause the landslides and falls, especially if the underlying rock is of a soft and friable nature, and is, therefore, liable to being washed away easily. It is equally evident that on a slope, which is denuded of trees, avalanches are more likely to occur and will be more destructive than on a forest-clad hill, no matter how steep the incline may be. The influence of deforestation on valleys, even when situated at a distance, though less apparent and obvious, is nevertheless equally certain and disastrous.

Professor Moore quotes from Colonel Chittenden's recent paper on the subject (pages 19 and 20). As I have

elsewhere reviewed this paper and pointed out the inconsistencies, contradictions, and purely arbitrary statements, presented without demonstration, which it contains, I will not further refer to it, but I will quote from Colonel Chittenden's report on reservoir sites in the arid regions, in which he says:

"The forests ought unquestionably to be preserved and the government is the proper agency to do it; but the principal arguments therefor apply with accentuated force to the construction of reservoirs."

Professor Moore says "army and civilian engineers and meteorologists generally believe that the broken, cultivated, permeable soil is equally as good a conserver of the rainfall as the forest area itself." Here again Professor Moore obscures the point of this subject by talking about cultivated areas, although he knows perfectly well that his paper would be used as an argument against the preservation of forests on the steep slopes not suitable for cultivation. I protest against such misrepresentations in the discussion of an important measure. As a matter of fact, the only references in the reports of the Chief of Engineers to this subject which I have been able to find, are the following:

In the report for 1875, Vol. 2, page 172, reference is made to the paper of Wex, a prominent Austrian engineer, who wrote an elaborate argument in favor of the proposition that forests exercise an important regulative influence, and the statement is made by S. T. Abert, United States Assistant Engineer:

"This decrease is assigned to the devastation of the forests and the consequent decrease of atmospheric moisture —a cause often assigned but not yet demonstrated. * * * But whatever may be the causes operating, there can be little doubt as to the effect of the sediment brought down by the annual rainfloods."

On page 510 of the same report, Maj. Charles R. Suter, then in charge of the improvements on the Mississippi River, says: "The influx of sand *from above* must first be stopped; then the river will have a chance to clear itself, and as its width contracts the shores can be revetted to prevent any further injurious changes."

In the report for 1879, page 1211, Maj. Charles O. Allen says: "The weight of evidence collected by various writers upon the subject of rainfall seems to indicate that reforesting of extensive areas of country is followed by a more equable distribution of the rainfall throughout the year."

In the same report, page 1373, Assistant Engineer T. P. Roberts says: "The clearing of forest lands, I believe, is followed by greater fluctuations in our rivers. I think the storm-waters undoubtedly reach the streams more rapidly now than formerly."

And in the report for 1891, page 1107, Maj. Charles W. Raymond, one of the most scholarly and capable officers who has ever been connected with the corps, makes the following forcible statement, which it may be well to quote in full:

CAUSES WHICH INCREASE THE DESTRUCTIVE EFFECT OF FLOODS

Such causes may be considered under the three following heads:

1. Destruction of forests and cultivation of land.
2. Artificial constructions, such as bridges and dams.
3. Collection of logs, lumber, and ice in the stream and upon its banks.

1. *The destruction of forests* from the mountain crests and slopes of a watershed *is undoubtedly the principal cause of the increase of the average magnitude of floods.** The evidence collected during the last twenty-five years establishing this conclusion *is well-nigh overwhelming*, and it is verified by repeated observations, not only in the mountains of Europe, but also in our own land. By the removal of the forests from the mountain slopes the ground is robbed of its protecting covering of roots, moss, leaves, and porous soil, which forms the forest floor and serves as a natural storage reservoir, holding back the water of rainfall and melting snow, and compelling it to descend slowly to the channels. By the subsequent cultivation of the lands, ditches and drains are made to facilitate the more rapid discharge from

the cultivated surfaces, until the rain rushes down the hillsides in destructive torrents, gullying the ground and choking the minor lines of drainage with rocks, sand, and gravel, and hurrying into the recipient of the watershed volumes of water which before reached it in a comparatively quiet flow.

Colonel Torrelli affirms as the result of careful observations that four-fifths of the precipitation in forests is absorbed by the soil or detained by the surface of the ground, to be gradually given up in springs and gentle rills, and only one-fifth of the precipitation is delivered to the rivers rapidly enough to create floods. Upon the same slopes and surfaces denuded of their forests, the proportions are reversed.

That the destruction of the forests in mountainous watersheds is followed by disastrous floods where previously such floods were unknown is not a matter of theory, opinion, or probability, but it is a well-established physical fact.

* * * The method of prevention by the maintenance and planting of forests upon the headwaters and upper slopes of the affluents of the basin depends for its efficiency upon the ability of forest-covered slopes to retain for a considerable time a large percentage of heavy rainfall, thereby preventing the surcharge of the lines of drainage. *In France, Italy, Germany, and Austria the systematic planting of mountain slopes as a means of restoring lost fertility and preventing the inundations following the destruction of forests, is an established fact followed by results more satisfactory than the most sanguine anticipations.*"

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*The following information with reference to the deforesting of the watershed of the West Branch of the Susquehanna was received after the completion of this report:

Lumbering operations were commenced in this region in 1850, but no systematic record of the amounts cut was kept until 1862. In the latter year the cut was 38,000,000 feet board-measure. It rapidly increased until it attained its maximum of 319,000,000 feet in 1873, and then fell to about 212,000,000 feet in 1890. The total amount cut since 1862 is about 5,250,000,000 feet board-measure, which represents about 30,100,000 logs.

In the year 1880 the timber on nearly 700,000 acres of land in Pennsylvania was destroyed by fire.

The above statements are based on the census report for 1880, and on information furnished by Mr. George S. Banger, Secretary of the Susquehanna Boom Company.

There is at least one officer of the United States Corps of Engineers who is acquainted with the teachings of experience.

Colonel Chittenden himself, the officer who has most recently written on the subject, apparently believes that the sediment carried by the Mississippi River into the Gulf of Mexico comes entirely from the mountain areas at the sources of the tributaries, for he says:

"It must be clear from the foregoing that the bottom-lands of the Missouri add nothing whatever to the total quantity of sediment that passes out of the mouth of the stream, for these bottoms have been increasing rather than diminishing in quantity. Likewise, the Mississippi bottoms contribute nothing to the volume of sediment that is carried *into the Gulf* of Mexico. It all comes from the uplands far and near, but principally from the more remote and hilly regions. This load is in the nature of through traffic. The local freight picked up from a caving bank is mostly discharged at the next station. It follows, therefore, that if the banks of these streams were revetted from the Gulf to Pittsburg, the Falls of St. Anthony, and the mouth of the Yellowstone, the quantity of sediment passing into the Gulf would not be diminished a particle."

In my previous discussion of Colonel Chittenden's paper, I have shown, I think, the incorrectness of this statement. Any sediment washed into a river, whether from the uplands or from the banks in the lower portions, is gradually carried downstream and adds to the total volume of earthy matter that is being transported or moved by successive floods. But the point is, as indicated in the extract from Major Suter's report (and this is perhaps what Colonel Chittenden means) that unless the influx of the earthy material from the uplands and mountain slopes above the navigable portions is prevented, the protection of the banks along the lower navigable portions will not be sufficient to maintain, the navigation, because the channel will be gradually filled up by this sediment coming from above. As Major Suter says: "The influx of material from above must first be stopped."

EROSION

The most important question connected with this whole matter is the effect of the forests on erosion, which has been already incidentally referred to. This matter Professor Moore passes over with astonishing silence, and if it was his intention to offer a scientific contribution to the subject of the effect of forests, it is difficult to understand his reticence on this point. The fundamental principle is self-evident. The surface water running off from forest ground takes less earthy matter with it than the surface water from bare ground, from partially wooded ground, from grass land, or from cultivated land, especially on steep slopes. Land partially grown up in forest or bushes, or grass land, is of course better than cultivated land in this respect, but neither is anything like as effective as forest land. Forests, therefore, are the most efficient protection of the ground against erosion, and this is the strongest argument in favor of their preservation on steep slopes.

In his argument before the Committee on Agriculture, March 1st, Professor Moore stated that erosion was "a beneficent action." In his published paper, however, only about half a page has been devoted to this important subject as against fourteen pages to the entirely unimportant subject of the effect of forests on rainfall! In his paper he again befogs the issue on this point by bringing forward the argument that "every acre that will grow food for the people and thereby reduce its cost and furnish sustenance to the population and the teeming millions that are on their way to these shores, should be so employed." In other words, again "the pleading of the poor man's children for bread and meat" is allowed to stand in the way of the fair discussion of a great public policy.

Everybody knows that streams that flow from forested mountain areas are comparatively clear, while streams which flow from bare ground are comparatively muddy, and the efficiency of forests in preventing erosion of the ground is admitted by all competent authorities.

First in importance, then, is the effect of forests in preventing erosion; second is their effect in moderating, in general, the violence of floods and in maintaining a high low-water stage, and least or insignificant in importance is their effect upon climate.

RATIO OF MOUNTAIN WATERSHEDS TO THE TOTAL WATERSHED

Another claim put forward by Professor Moore is that the ratio of the mountain watershed in a large basin like that of the Ohio River, is so small that the reforesting of the mountain area will be of little benefit. A brief examination will show the fallacy of this and the unfairness of Professor Moore's reasoning, and to make this clear it will be necessary here to explain, briefly, the cause and action of a flood.

The fundamental cause of the flood, of course, as every one admits, is excessive and long continued precipitation over a large area. The rain which falls on the mountain sides is gathered rapidly into the brooks and larger streams, but much more rapidly from bare areas than from forested areas, and carrying much more sediment. The transporting power of water varies about as the sixth power of the velocity; that is to say, if we double the velocity of flowing water it can move a cubical particle of rock or earthy matter sixty-four times as large as before. The waters come down from bare hill-sides, therefore carrying large masses of sediment, and as the waters reach the upper navigable portions of the streams where the slope is flattened, they gradually deposit their sediment. Succeeding floods carry portions of this sediment further down, and so it gradually reaches—perhaps only after a considerable length of time—the lower reaches of the river. The immediate effect of deforestation on floods and on the deposition of sediment will clearly be felt first in the upper reaches of the streams; on the Ohio River, for instance, at Pittsburg and points above, rather than at Cincinnati, Cairo, Mem-

phis or New Orleans. It is hardly fair, therefore, as Professor Moore does, to compare the *mountain* watershed of the Ohio River with the *entire* drainage area of that stream. The mountain watershed is more fairly to be compared with the drainage area above Pittsburg, of which it would form a considerable proportion.

The sediment brought down by the mountain stream is, in the course of years, washed farther and farther down the river, and that carried in suspension is gradually deposited, as the slope becomes less and the velocity of the flowing water correspondingly less, in the bed of the stream. Subsequent floods find therefore a smaller channel in which to flow, the bed of the river having been raised by sediment brought down by previous floods. The floods, therefore, in the lower reaches, finding the channel contracted, are obliged to rise higher and to overflow bottom lands, and in doing so they wash away the banks where these are alluvial, causing still more material to be swept into the channel of the river. At the same time, some of the sediment from above is deposited over the bottom lands.

Now, the point is—and it may as well be once more emphasized—that even if the banks in these lower portions were protected against washing away, the gradual filling up of the channel of the stream by sediment brought down from above would in itself cause the floods to rise higher and higher as the years go by, and to overflow larger and larger areas. Once more to quote Major Suter and Colonel Chittenden, "the influx of sand from above must first be stopped."

To estimate, therefore, the value of the forests in preventing erosion, it is grossly incorrect to compare the mountainous area with the *total* area of a large drainage basin. If we could protect the mountain sides, and limit the erosion to what would naturally come from flat, cultivated land, and from caving banks, the problem would be comparatively easy; and it should further be noted that the erosion from flat, cultivated lands can be largely prevented by proper methods of cultivation and plowing, which will not allow the water to flow with great velocity through the furrows. Plowing should be done not up and down the slopes, but along the contours. Land suitable for cultivation should be used for cultivation if necessary, but there is nothing in all this discussion of Professor Moore's which casts a shadow of doubt on the efficacy of the mountain forests as conservators of the navigability of streams.

Before leaving this subject, it may be as well to say that probably the best authorities upon it are neither meteorologists nor engineers in general practice, but foresters and forest engineers, and that these are practically, if not quite, unanimous as to the value of forests. An engineer whose duty it is to maintain harbors and the navigable portions of streams, like the officers of our Corps of Engineers, does not, in the course of his daily experience, have much opportunity to observe or study forest questions. He sees banks cave and the material form a bar below; he does not see the constantly-moving mass of sediment in the bottom of the stream; he does not see the erosion on the mountain slopes; out of sight is out of mind, and he may easily fail to recognize the importance of what he does not observe. Professor Moore admitted that he had never studied erosion in the mountains, and yet he presents a paper which dismisses this most important element in less than one page and which is offered as a presumably weighty contribution to a great subject!

A volume could be filled with quotations from the writings of those who have observed this matter, but as an illustration only one will be given from a review of a work published in 1901 on "Forestry in British India," by Berthold Ribbentrop, who has spent thirty-four years in the forest service.

Statements like this should overbalance a thousand statement like those in the paper we are considering:

> In the Hoshiarpur district of the Punjab the Siwalik range of hills stretches from the Bias to the Sutlej River in a southeasterly direction. These hills consist of a very soft friable sandstone, alternating with strata of loam and clay. Formerly these hills were fairly well wooded. In 1846 they became British territory; the consequence was a rapid increase of population, a great demand for wood and charcoal in the fertile plains below, and the influx of a floating population of graziers with large herds of cattle. The result was complete denudation of these hills; the loose soil, no longer protected by vegetation, was washed down, broad rivers of sand spread into the plains below, and the end has been that fields and gardens of 940 villages, once prosperous, are now covered with sand, which has laid waste upward of 70,000 acres of fertile lands. This district, rich formerly, is now traversed by numerous broad, parallel sandy belts, cut out of the fertile and crop-bearing area.
>
> Efficient protection of the reserved forests was only commenced a comparatively short time ago, and yet the author is able to state numerous instances from different parts of the country, in which protection has completely changed the character of the torrents and streams taking their rise in the forests. After rain, the water no longer rushes down, carrying sand and silt with it; the channels have been confined into permanent beds; they have become narrower and deeper, and the old beds to the edge of the channel have become stocked with grass and thousands of seedlings. * * * The denser vegetation, which is the result of efficient protection, has everywhere counteracted erosion, has prevented landslips and sudden floods.*

ARE FLOODS INCREASING

Professor Moore devoted thirteen pages of his thirty-six to the discussion of this matter, in which he criticised the discussion of Mr. Leighton of the Geological Survey, and of Messrs. Hall and Maxwell of the Forest Service. His objections to these two papers are the following:

First: He claims that they discuss "not floods as such, but moderate stages of the river."

Second: He maintains that their method of discussing the observations is incorrect.

I have not at my disposal the records bearing upon this matter and therefore cannot, even were it desirable, here discuss them in full. Mr. Leighton's discussion of the Tennessee River compares the conditions existing in the twelve years 1884 to 1895 with those existing in the twelve years 1896 to 1907. Professor Moore admits that this period of time is too small to allow of definite conclusions being drawn. He further says that "no records or other evidence are presented that there is not as much forest area in this basin as there was twelve years ago." The most that can be said, therefore, with reference to this discussion is that the evidence is not sufficient to justify definite conclusions either way. Personally, I think the figures given by Mr. Leighton indicate an increase in floods, but not having the full data at hand, and particularly data as to the forested area, I believe this is simply another illustration of the fact that the statistical method is of very limited use, and perhaps of no use at all, in the case of meteorological and hydrological phenomena covering so short a period of time. Professor Moore apparently takes the same view, for he says: "No matter how complete the data may be or how fundamentally sound and fair its collation and grouping, the comparison, the one with the other, of such short periods as those measured by only twelve years cannot give results with regard to changes in climate and floods that will permit the most skilled meteorologist or engineer to draw fundamental conclusions that can have any value."

If Professor Moore had stopped here we could agree with him on this point. Unfortunately, however, he goes on to give what he considers a different and more reliable form of investigating this question of the relation of precipitation to run-off. For this purpose he takes the records of the height of the Ohio River at Cincinnati from 1871 to 1908, and from a consideration of these results he draws the following definite conclusions: (p. 33)

"The average discharge of the Ohio River where, *I presume*, deforestation has been as great as in any other part of the country during recent times, has not changed for a period of thirty-eight

**Nature*, April 18, 1901.

years except as caused by precipitation." He draws this conclusion from the following facts:

Average stage of the Ohio River at Cincinnati, Ohio,

	Ft.
1871-1889	17.3
1890-1908	17.5

Average precipitation in the Ohio watershed:

	In.
1871-1889	41.3
1890-1908	41.8

Professor Moore is apparently willing to draw definite conclusions from insufficient data where this data indicates to him that forests have no effect. He criticizes others for drawing definite conclusions where the reverse is indicated. Only on page 28 he has made the remark, which is perfectly correct, that: "Precisely the same amount of rain falling in the two periods and no change whatever in forest or cultivated area, might produce largely differing results on floods;" and yet, because the average stage of the Ohio River in the two periods corresponds, in general, with the average precipitation, he concludes that "the average discharge has not changed *except as caused by precipitation.*"

Now, the fact is, that Professor Moore's figures give no indication whatever of the discharge of the river. He is evidently ignorant of the fact that a given river at a given place, when the water stands at a certain height on the gauge, may be discharging much more or much less than it may be discharging at another time when the water stands at precisely the same height. Readings of gauge heights are very inaccurate indications of discharge. The discharge of a stream depends not upon the gauge-height alone, but also upon the *slope of the surface of the water,* not upon the slope of the bed of the stream. A channel may have a level bed for a mile, but if the depth of the water at one end of the distance is greater than the depth at the other end, there will be a rate of discharge, depending upon the slope of the surface as well as the depths. On the other hand, if the bed of the stream is inclined, but the water surface level, so that the depth is different at the two ends, there will be no discharge. When a flood wave comes down a river, the front of the wave is steeper than the back, and when the water reaches a given height on a given gauge, and is rising—that is, when the front of the wave is passing, the slope of the surface of the water will be greater and the discharge greater than when the crest of the wave has passed and the water stands at the same height on the gauge as before. It is, therefore, fundamentally wrong to draw any definite conclusion with reference to the *flow of a river* merely from observations of the gauge-heights. It is equally incorrect, as Professor Moore does, to draw any conclusions with reference to the increase in number and violence of floods from the number of days at which a river stood above a certain stage. In his testimony before the Agricultural Committee, Professor Moore, when confronted with these facts, said that it made no difference whether the discharge was measured by a gauge-height or not, flood conditions were to be determined by the number of days at which the water stood above a certain height.

Now, let us suppose that from 1865 to 1885 on a given stream, there were forty floods in which the water stood above a given gauge-height at a given place, an average of four days for each flood, or 160 days in all; and that between 1885 and 1905 there were eighty floods in which the water at the same place stood above the same height an average of two days each, or 160 days in all, the same as before. According to Professor Moore's discussion, the conclusion would be that the floods were not increasing because the total number of days at which the water stood above a given height had not changed!

I think it will be clear from the above remarks that Professor Moore's figures prove nothing whatever. As a matter of fact, the effect of the removal of forests, (reasoning now deductively) is unquestionably to increase the suddenness with which the flood waters are gathered into the streams. It is therefore fair to believe that such deforestation increases the number and suddenness of floods, diminishing also their duration. The damage done by floods clearly does not depend simply upon the number of days of flood. If an area is partly submerged it makes comparatively little difference whether the submergence lasts four days or ten days, the damage is not thereby increased perceptibly; but if, after one flood has subsided, there comes another one after an interval of a few months or a few years, although both may be short, the damage will be approximately doubled.

Other points in Professor Moore's paper might be criticised, but this discussion is already too long, and they will be passed over. It is much to be regretted that the head of a presumably scientific department of the government should, while claiming to be in favor of forest preservation, have produced such a paper as the one under consideration, the influence of which—so far as it has any influence—would be to discredit action which, as already stated, depends for its legality upon the effect of forests on the navigability of streams. Professor Moore's paper, in which he practically leaves out of account entirely the question of erosion, which is the most important one of all; in which he attempts to prove that on certain streams there has in recent years been no increase in floods, but in connection with which discussion he offers no figures regarding the decrease or increase in forested area, and on which, as has been shown, his argument is in many respects unscientific and proves nothing; and in which he devotes a large amount of space to the entirely unimportant question of the effect of forests on rainfall, the general effect of which is to lead the mind to the conclusion which may have been desired, but which certainly has not been proved, that forests are of little value as regulators of flow, is much to be deplored. The matter is one of national importance and simply involves the question whether we shall learn by the experience of other countries, in which deforestation of mountain areas has resulted disastrously, or whether, with the rapidly increasing demand for wood, we are to allow our mountain forests to be rapidly destroyed. The beneficial effect of such forests on the navigability of streams, is, as has been shown, unanimously agreed upon by foreign engineers, although of course, no one attempts to state that effect quantitatively. There is, therefore, ample scientific justification for the acquirement by our government of forest reserves in the East. The fact that there are many other reasons why such forests should be preserved, some of which may be stronger than the beneficial effect of forests on navigation, is certainly no reason for neglecting to take action whose legality is amply justified by experience.

CLASSIFICATION OF WOODS BY STRUCTURAL CHARACTERS

By C. D. MELL, Assistant Dendrologist, Forest Service

INTRODUCTION

THE study of wood for the purpose of finding structural characters, on which to base a classification is still in its infancy. No one has published anything comprehensive on the subject, although it is pretty generally recognized that an intimate knowledge of woods is one of the utmost practical importance. The principal contributions to this branch of dendrology have been made by students of botany in the German universities where all technical investigations are greatly encouraged. Since the introduction of forestry into this country a good part of this information has been translated into English directly by those familiar with German. Much has been contributed in this way to the English literature of the subject. Books on the botanical characters of American trees are being constantly written, but up to the present time no one has written a work on the structural characters of the wood, with which the forester should be quite as familiar as with the characters of the leaf, flower, and fruit. Ever since timber has been bought and sold dealers have been relying on the "rule of thumb" method for discriminating between woods. This method is sufficiently reliable for the carpenter or the timber merchant, for he deals with only a few kinds of woods and a knowledge of their general properties is easily gained through the senses of sight, touch, smell, and taste. Anyone who constantly works with certain woods can easily distinguish them by their most obvious characters. A new wood, however, will leave him entirely at sea, nor will his method suffice for the forester who deals with a good many different species. It is necessary, therefore, to have much wider information, methodically arranged, to help out the rule of thumb method.

LITERATURE DEALING WITH WOOD STRUCTURE

Unfortunately there are no English publications that contain a scheme of classification for even a single group of woods. J. S. Gamble's "Indian Timbers" is a most excellent work, but it does not give very definite information helpful in identifying the timbers of India from their structural characters. Gamble does not attempt to point out the chief features even of the most important woods. Sir Dietrich Brandis' book on "Indian Timbers" is the best descriptive English work. Although this work is the most authoritative of its kind, the author has taken more pains to give the botanical characters than to point out the chief distinctive features of the woods themselves. Thomas Laslett's "Timber and Timber Trees, Native and Foreign," does not contain anything that approaches a key even to the most important kinds. Dr. Marshall Ward's book dealing with timber and some of its diseases contains some very helpful suggestions relative to the importance of a scheme of classification. Herbert Stone's works, chief of which is "The Timbers of Commerce," are among the latest books dealing with the structural characters of commercial woods. His "Timbers of Commerce" is also very helpful both to the forester and the timber merchant, but it lacks a discussion of the structural characters. Dr. G. S. Boulger's book entitled "Wood" (last edition) is an excellent work and

contains a key to some of the European woods. The author does not give a great deal of original matter in this book; the analytical key appears to be chiefly from Dr. Robert Hartig's "Timbers and How to Know Them."

Students of wood structure in America are less numerous. Chief among those who have done orginal research is Dr. D. P. Penhallow, whose labors on the North American Gymnosperms extend over a period of twenty years. He is easily the greatest living authority on the anatomical characters of the North American Gymnosperms. Romeyn B. Hough's sections of woods deserve praise, for they offer the named wood itself for comparison which lends much assistance to dealers in American woods. Among others who have done work along this line are Roth of Michigan University, Jeffery of Harvard University, Sudworth of the United States Forest Service, Toumey of Yale University, and Snow of New York University.

It is to the Germans that we must look for substantial progress in this work, and chief among them is Radlkofer and the botanists of his school. Dr. Hans Solereder worked out a classification based on purely morphological characters. Unfortunately, however, he confined himself to the examination of small twigs, and consequently included characters that belong only to primary wood, which yields few characters present in market samples that consist wholly of secondary wood. Nordlinger has briefly described 1,100 species from small transverse sections. A number of these sections, however, as is true also of Solereder's, are taken from small twigs which do not show structures characteristics of secondary wood. Nordlinger did not make a key for tracing down the woods to the group to which they belong. Although a number of German botanists have confined their attention to particular groups of woods, they have accomplished a great deal of good. Among them are Abromeit on the Cupuliferæ; Beyer on the Anonaceæ; Burgerstein on the Pomaceæ; Dippel and Mayr on the Coniferæ; Goppert on the Magnoliaceæ; Hitzemann on the Dipterocarpaceæ and Chloenaceæ; Jaensch and Saupe on the Leguminaceæ; Knoblauch on the Laurinaceæ; Moll, Janssonius, Reinsch, Schroder, Schwartz, Springer, etc. Altogether a great deal has been done by the different investigators toward making a key based on the anatomical characters found in wood. If the knowledge now accumulated in English and German publications could be simply compiled a very valuable work would be done.

THE IMPORTANCE OF MICROSCOPICAL RESEARCH

An investigation of this kind has always been considered one of great importance, and it does not require any extended defense. What is needed is simply the collection and determination of special, well-chosen structures, so recorded that they may be readily referred to when needed.

If only a few objects are to be classified it may not be necessary to compile very many distinguishing characters, but when the objects run up into the thousands it becomes necessary that the characters employed in a key be multiplied accordingly. The required number of characters can not be determined by the unaided eye or even with a hand lens; on the contrary it may require the closest observation with the highest power of the compound microscope in order to detect a sufficient number of constant characters. Objections have been, and may well be, raised against such microscopical research on the ground that the results will be too technical to be useful to the mass of wood users most in need of a key. English timber merchants have tried for many years to prepare a key based on the more obvious gross characters for the reason that they are not equipped to make a microscopical examination of woods. The time has arrived, however, when the number of foreign woods in general use is becoming so great that a knowledge of the gross characters alone will no longer answer as means of iden-

tification. Purposely or through ignorance, importers appear constantly to be endeavoring to palm off upon their customers substitute woods, sometimes inferior, whose superficial appearance is close enough to deceive the uninitiated. The real mahogany, *Swietenia mahogani* is now becoming scarce, and at least a score of different woods from Central and South America, India, Africa, and the Philippine Islands, are being sold as the "only genuine mahogany." The Australian eucalyptus and a number of other woods are being so skillfully stained to imitate ebony that no one except an expert can distinguish the counterfeit.

Dr. Schlich once remarked that as the timber supply declined in the northern hemisphere another suitable source of supply must be looked for in the southern hemisphere. The demand for different woods and the growing scarceity of the most useful kinds in this country forces us to go to the tropical countries of the southern hemisphere for millions of feet annually. The foreign woods now in general use are too numerous to be distinguished by superficial characters. We must look to minute structural characters as a means of tracing down woods with which we are not familiar. For this, recourse must be had to the microscope. The result of such investigations are far reaching in usefulness, including the needs of the forester, lumberman, and timber merchant, and even of the pharmacist. There are numerous medicinal properties derived from different woods, and it is very important in their preparation that the right kind of wood be used. There are certain woods, for instance, that resemble quassia in external appearances. In order to detect the numerous attempted uses of these as substitutes or adulterants of genuine quassia, it is necessary to know the microscopical characters of quassia to distinguish the real from the spurious wood.

Work of this character is primarily technical, but it does not aim to replace entirely nor to underrate the old rule of thumb method. Attention is drawn only to the necessity for more scientific investigations of woods and the compilation of existing expert knowledge as a means of meeting the needs of technical institutions and of private persons possessed of the training and equipment to make use of such help. It is not implied by this that the more obvious characters of woods seen in the block should not form part of the natural system so far as they can be made to serve. Such characters of wood, as color, weight, hardness, and odor, often help in making determinations. So also color solutions, obtained by boiling the wood in water, acid, alkali, iron salts, or glycerine, yield very valuable and interesting data. Even burning tests are often helpful in discriminating between woods. For example, the eucalypt Jarrah always burns to a black ash, while Karri, another species, burns to a white ash. The importance of such characteristics can not be too greatly emphasized.

Since systematic botanists generally have no special concern in the identification of woods, it is a task that naturally devolves upon the foresters who are professionally interested in the uses of this and other forest products. The field is so large and all-absorbing as to require specialization apart entirely from other branches of technical forestry. It requires a specialist trained not only as a lignologist, but also as a botanist. Moreover work of this character requires a most sedulous investigator with one aim, the good of the work.

Such a work as this has fitly become, with other dendrological investigations, a most important economic study in the Forest Service of the United States Department of Agriculture. The results, which are being very rapidly put into shape for publication, are practical aids to practical manufacturers and users of woods, as well as to other students of trees and other products.

PROTEST AGAINST THE WOODSMEN OF THE FOREST OF GASTINE

By PIERRE DE RONSARD (1524-1581)

Translated by Bristow Adams

[This poem by Pierre de Ronsard is historically interesting, since it shows a sentiment for forest preservation in France in the middle of the sixteenth century. France has suffered greatly from forest destruction, and in recent years has been at great pains and expense to repair the damage. The naive philosophy of the last two stanzas is somewhat prophetic, as poetry often is, of the changes to earth forms that may, and do, come about through forest destruction and its attendant evils. The poem is, of course, far from the modern spirit. The original meter and rhyme-scheme have been retained. B. A.]

Ah, woodsman hold! Stay thy destroying arm;
These are not trees that thou dost bring to harm.
Dost thou not see the blood that trickles dark
From veins of nymphs that dwell beneath the bark.
If murderers deserve the stake, the rope,
How much less thou shouldst ever dare to hope
For mercy from such punishments as these,—
For thou art killing our divinities.

O, forest home in which the song-birds dwell!
The squirrel and the stag shall miss the spell
Of thy cool depths when summer's sun assails,
Nor more find shelter in thy shadowed vales.

No longer will the love-lorn shepherd lean
Against thy trunks; nor will his pipes shrill keen—
His dog at heel, his crook beside him set—
The tale of love he bears the fair Janet.
All will be silent; Echo will be dead;
A field will lie where shifting shadows fled
Across the ground. The mattock and the plow
Will take the place of Pan and Satyr now.
The timid deer, the spotted fawns at play
From thy retreats will all be driven away.

Farewell, old woods where Zephyr played so free;
Where first I turned my soul to poesy;
Where first I heard Apollo's arrows whirr;
Where first I heard my better impulse stir;
Where first I met Calliope divine,
And through her learned to know the Muses nine.
Their wreaths of roses on my brow were pressed
The while Euterpe held me to her breast.

Farewell, old forest, sacred crowns farewell!
Revered in letters and in art as well
Thy place becomes the scorn of everyone,
Doomed now to burn beneath the summer sun.
All cry out insults as they pass thee by,
Upon the men who caused thee thus to die!

Farewell, old oaks, that once were wont to crown
For deeds of valor and of great renown!
O trees of Jupiter, Dordona's grove,
How ingrate man repays thy treasure trove
That first gave food, that human-kind might eat,
And furnished shelter from the storm and heat.

Ah, how unhappy he, that pins his faith
In forms that will but vanish as a wraith;
How true it is that everything must change,
And take on habits that are new and strange!

The peaks of Athos shall in plains be lost;
The Vale of Tempe to a mount be tossed;
Where Neptune rules shall all be sowed to grains;
All form is lost; matter alone remains.

CORRESPONDENCE AND QUERIES

Natural Checks to Distribution of White Pine

The Editor of American Forestry:

While studying charts of distribution of certain species of conifer, I could see no reason why the white pine (*P. strobus*) should not occur indigenously in abundance near my country place at Stamford and Greenwich, Conn. There was no natural check in evidence, and I proceeded to set out several thousand of these trees, along with other conifers seven years ago. Every year since that time more white pine have been added, but it is apparent that the species cannot be expected to thrive in this region, which the charts show is normally favorable. My loss amounted to something like 10,000 white pines, varying in age from two years to ten years at the time of transplantation. These trees came from various nurseries, and some were raised from seed in my own nursery. Some were common seedlings, others were stock "transplants," and the larger ones were chiefly shipped from nurseries, with balls of earth about the roots of the trees. A few hundred trees were lost in ordinary ways—girdled by rabbits and field mice, terminal buds eaten by red squirrels and roots eaten by pine mice, but the sweeping destruction has been caused by the white, wooly aphis and by another aphis which I have not classified. The latter is not so abundant as the white aphis, but it multiplies on individual trees so rapidly that the tree is more quickly destroyed. It is a small, dark-colored aphis which runs nearly as rapidly as the ant guardians when disturbed. The only white pine trees that I have been able to save are a few that have received constant supervision on the part of my superintendent, who personally wipes every infected area of bark with a sponge soaked in a decoction of Persian insect powder. He goes over each infected tree several times in the course of a season, and will not allow any of my other employes to take the responsibility of caring for the few living white pines. Tobacco stems are used for mulch about the roots of these trees. Trees which have been lost by the thousand were set in all sorts of soil,—swamps, sand, rocky cliffs and rich cultivated ground. All shared the same fate, in a general area something more than a mile in length. Here and there in the neighborhood, on other properties, a very few white pines are seen, but it is my feeling that this region is unfavorable for white pine, not because of soil or climate, but because the two species of aphis have been indigenous to the locality, and have always served as a natural check to distribution of this species of pine.

ROBERT T. MORRIS.
New York.

EDITORIAL

The Weeks Bill Reported

AS FORESHADOWED in the pages of this magazine last month, the Committee on Agriculture of the House of Representatives voted to report the Weeks bill for the purchase of national forest land. The vote in the committee was ten to seven in favor of so reporting. Chairman Scott, Mr. Haugen of Iowa, Mr. Hawley of Oregon, Mr. Howell of Utah, Mr. Chapman of Illinois, Mr. Beall of Texas, and Mr. Rucker of Missouri, voted against it as they have always done. Mr. Stanley of Kentucky, a good friend of the bill, was absent on account of illness, so that the actual poll of the committee on reporting the bill was eleven to seven. Two or three of those who voted for the report, however, reserved the right to take such action as they deem wise when the bill comes up in the House. The report for the majority of the committee was put in charge of Mr. Lever of South Carolina, and Mr. Plumley of Vermont.

Mr. Weeks has reintroduced his bill, with certain minor amendments that do not change in any respect the substance of the bill. This statement is made here to explain variations that may be found between the bill as it will be before the House and the copies of it that have been issued up to this time.

The bill is now before the people of the country for action. There will be a hard fight against it in the House and probably another in the Senate. The work of informing the people and their senators and representatives must, therefore, go on with increased thoroughness, for the bill must be passed at this session. A recent advice from New England says that "the condition in the White Mountains is such that if the matter goes over to the short session it means grave and irreparable loss." We know that this is no idle word. The men who play with constitutional quibbles, or spend their time in considering engineering subtleties, should go up into the great woods among the hills and see what destruction is being wrought by man and the forces of nature that his work has let loose. One day of the real thing would be worth a week of arguments in committee rooms.

In the Sixtieth Congress, Mr. Weeks of Massachusetts and Mr. Lever of South Carolina were actively in charge of the bill in the committee. In the present Congress, Mr. Weeks is no longer a member of the Committee on Agriculture, though he retains his keen interest in this legislation and has personally prepared the bill which bears his name and which he will actively champion in the House. The work of managing the bill in the committee this year was borne by Mr. Lever of South Carolina, and the thanks of every friend of the Appalachian Mountains, north and south, are due to him for his earnest, painstaking, and capable work. He has made a thorough investigation of this subject, his efforts in its behalf have been a labor of love as well as duty, and his management so far has been most wise and successful. He has been ably assisted by Mr. Plumley of Vermont, a new member of the House and a new member of the committee, but one who has brought to the consideration of this subject a valuable knowledge of New England conditions and the legal acumen which long ago won him recognition as one of the foremost lawyers of his state. Friends of

forestry, and particularly of the Appalachian forests, have reason to be grateful that the place from which we miss the Hon. Kittredge Haskins has been filled by so able and so friendly a successor.

Not a One-man Cause

WE FIND in a somewhat lurid editorial comment on the Pinchot-Ballinger investigation this statement: "So far as this generation is concerned it now appears that that principle (conservation) will stand or fall with Gifford Pinchot."

To this we wish to take decided exception. It is worth noticing if only because it represents quite a widespread sentiment among admirers of Mr. Pinchot and one which we think does injustice to him as well as to the cause of which he has been one of the apostles and leaders. AMERICAN FORESTRY can not have left any doubt as to the extent and quality of its respect and regard for Gifford Pinchot, but the principle of which he has been one of the chief evangelists and organizers is greater than any man, nor is it praise for him to say that the government service which he built up from almost nothing is so weak that it will fall without his guidance, or that the cause that he is advocating so unselfishly and so brilliantly has no hold outside of his personality. The idea of forestry and conservation has become impressed upon the thought and convictions of the American people so thoroughly that it will be permanent. The truth is greater than any one man.

Nor does he stand alone. There were other wise men and prophets before him—men upon whose achievements his great work was builded, and most of them are still with us. They and he have given powerful inspiration to a generation of young men of faith and energy, and to a great body of people who have come to know the truth and have organized to maintain that truth. Nature is teaching the lesson from day to day so that he who runs may read. The minor incidents of legislative politics should not blind us to the real bigness of the issue and the tremendous power of facts. The removal of Mr. Pinchot from the Forest Service did not eliminate him. His technical defeat, if that should happen, in the congressional investigation in which he has played so prominent a part, will not change the popular conviction that he and the men who have fought for the salvation of the people's heritage from conversion to the personal profit of a few are right in principle—and that principle will hold its own.

If the law and the constitution do not protect the interests of those for whom they were created we shall still uphold the law and the constitution, but they will have to be made to serve the purpose for which they were created, and that was not to serve private interests or secure exclusive privileges to a few, but to promote the general welfare of the whole. We shall soon learn, if we do not already know it, that those words "the general welfare," at which the constitutional lawyers sometimes shy, are really the key note of the Constitution of the United States. We should repeat that pregnant phrase "government of the people, by the people, and for the people," until its meaning and spirit are indelibly printed on heart and brain. That is what we are slowly coming to—the comprehension of a great truth. Personalities are only incidental, great and valuable though they may be.

Pulp Wood Economies

THE article by Mr. Griffin on economic selection and processing of raw materials in the paper industry, published last month in AMERICAN FORESTRY, is suggestive of a great opportunity for economy in production that will sensibly promote the conservation of our forest resources. Mr. Griffin shows that the wide variation in the character

of paper products offers an opportunity for adaptation of the raw material which our manufacturers have not sufficiently availed themselves of. Therein also lies a reason for the failure of some of the fibres that have been proposed as a substitute for wood as a base for paper making. They have not been rightly applied. We believe that there is here a wide field for economy of the forests by the use of annual plants of rapid growth and that close study of its possibilities will be of advantage to paper makers and to the country in this age of disappearing forests. The late Edward Atkinson, the well-known Boston economist, instituted and was conducting at the time of his death experiments in the use for paper making of the tall grasses that are now grown wholly for ornamental purposes. Mr. Atkinson believed that he had found an easily grown new paper material, and he was one whose imagination always confined itself closely to the narrow path between the hedgerows of close-clipped facts. Since his death we have heard of no continuance of those experiments, but they were certainly worth while. Perhaps our resourceful Department of Agriculture might take them up.

A Western View

IN THE *Pueblo* (Colorado) *Chieftain* we find a notably fair and intelligent discussion of the question of conservation of western resources, which is entitled to careful consideration for it undoubtedly represents one of the best western points of view, while it comes from a part of the country from which we hear much intemperate and utterly prejudiced ranting against forestry and conservation. The article begins as follows:

> The true friends of conservation in the west realize that they are confronted with danger on both sides. The opponents of the conservation policy in the western states are, for the most part, either men that seek to gain a selfish profit through a continuation of the policy of spoliation and monopoly, or men that are striving to score a partisan point against the administration and the party in power.
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> On the other side, many of the advocates of conservation in the eastern states and some of those that are participating as officials in the institution of the conservation policy, have an avowed purpose to establish and maintain a great national domain which is to be administered for the benefit of the federal treasury and not for the individual benefit of the citizens of the states in which the national lands are situated.

With respect to the latter paragraph it may be suggested that the great national estate or domain already exists, and has existed since the Louisiana purchase and the Mexican cession, that it is the property of the whole people and that for reasons which the article we are quoting calls attention to in succeeding paragraphs, it should be administered for the benefit, not indeed of the federal treasury, but of the people of the United States. And this administration for the people of the United States will inure most directly to the benefit of the people of the western states in which this domain is located. The *Chieftain* continues:

> Under such conditions it is important to recall what was the original purpose of the land laws, what have been their degrees of success, and in what particulars they have proved to be faulty or opposed to the public interests. The main purpose of the land laws was the disposition of the national resources, and primarily the agricultural lands, among individual holders. It was not regarded as good judgment to build up a great system of tenantry or to hold title to the national lands in the nation. The ideal condition was thought to be that of an agricultural population owning their own lands. That purpose is just as important now as it ever was, and no modification should be tolerated that tends to build up a great permanent national estate in mines, in forests or in agricultural lands.

With the main idea of this statement we are in cordial agreement, but in particulars it requires modification. It is perfectly true that there should be no building up of great national holdings of agricultural lands. It is for the interest of the nation, both east and west, that its agricultural lands should be divided in small holdings among individual resident owners. With regard to forest land, however, conditions are en-

tirely different. We have learned now that our national resources in forests are not inexhaustible and that the highest scientific skill must be used to foster the supply. There are large areas of land suited only for forest production and in no respect adapted to agricultural purposes which can add to the wealth of the nation only by growing forests. It is perfectly well understood that the growing of forests in these mountains offers too many difficulties for the private owner and will only be carried on by the state or the nation, and that if they are not so managed and controlled, they will fall into the hands of great corporations which will exploit them for immediate profit and thereby the permanent interests of the nation will suffer. And this suffering falls most on the people of those states in which the forests are situated, and which are necessarily the most direct beneficiaries of the many blessings the forests can bestow upon the people in whose territory they lie. The *Chieftain* goes on to admit this point and states the case very clearly.

> But it has been a defect of the land laws that they have tended toward the creation of monopolies. This is not true of agricultural lands, because the nature of their use and occupation has made it difficult to keep large holdings in individual ownership, and the tendency has been rather to break up large holdings, where these existed, into smaller farms.
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> But with the mines and the forests the case has been different, and the mines and the forests and lands not suitable for farming have increased greatly in relative importance in recent years. This is especially true of the coal fields, of the oil fields, of the water powers, and of other resources that lend themselves easily to single ownership in large bodies and that increase rapidly in value without the expenditure of money for their maintenance or development.
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> The conservation movement owes its initiation and its strength to the knowledge that the national resources are in serious danger of waste, of depletion, of extortionate exploitation, and that the only remedy for these imminent dangers must be found in such a modification of the land laws as will give the people of the nation, acting through the government, power to protect themselves from these evils.
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> For many reasons the conservation movement might be better left in the hands of the state governments, rather than in the hands of the federal government, if it were not for the fact that in many cases the states themselves are held in the power of precisely the powers and influences against which it is necessary to guard the people's inheritance. In some western states it would be nothing more than a farce to turn the coal lands, the water powers and other resources over to the state legislatures for protection, when the majority of the members of those legislatures are customarily elected and controlled by the big corporations of those states.
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> That it is entirely possible to conserve the national resources in such a way as to prevent monopoly and at the same time to secure the original purpose of the land laws, is not a matter of doubt, for it has been demonstrated by the very effective work that has already been done.
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> The objects of the conservation movement ought to include a reasonable use and development of the national resources, and this use should be equally free from the extortions of a private monopoly and from the service charges of the federal government.

If by service charges of the federal government, the *Chieftain* means reasonable charges for use—for grazing, waterpowers, and so on—its view that such charges are improper is an incorrect one. The government, the federal treasury, are not things apart and served in and for themselves. The payments made for the use of the national domain are for the benefit of the whole people whose territory this is. Those who derive the direct benefits of use therefrom may fairly be expected to pay to the people a fair compensation for what they receive, as to any other owner. We are slowly outgrowing the idea that the nation through its government can recognize any favored class or individuals. This is a matter of simple democracy and equity and not tyranny, oppression or extortion. We think that this is where some of our western friends make their mistake. They went out to open a new country and everything was free and the work of the pioneer was deserving of reward. But the country has been built up and large expenditures are being made by the national government to develop it,

and these expenditures result in a special benefit to the people of the western states. They create rich prizes for the careless freebooters who throng a new country, and instead of giving away privileges it becomes necessary to guard them closely. Why then, should not the national domains provided for the people of the whole country and which are maintained by the people of the whole country, bear their fair share through those who use them of the expense incurred in their maintenance? The time is coming, undoubtedly, when the western forests will more than pay their own expenses and will yield a return to the national treasury. This is the experience of all countries which have a national forest policy; but at present they are a source of expense which all the states pay.

We have quoted the article from the *Chieftain* fully, with some notes of our own, because we feel that the writer and ourselves are not so far apart on the general principle and that we could very easily get together on the details. There has been too much sectional feeling and too little understanding of the west by the east and of the east by the west. Suppose we start from the fact that the east is not a great soulless banking corporation and that the west is not a wilderness to be exploited and work up to a conception of the United States as one nation, with common interests, a common faith, and a common hope. Some of our Denver critics are hopeless but we think that with our friend from Pueblo we might climb the heights.

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The Cost of War and Peace

A STRIKING circular has been issued by the New York Peace Society showing the cost of armed peace to the people of the United States. In this circular several striking comparisons are made of the cost of the maintenance of our navy and the cost of many of the conservation enterprises which are proposed and upon the prosecution of which our legislators halt on the ground of extravagance.

For example, attention is called to the fact that the proposed White Mountain forest reserve could be purchased and planted for the cost of one battleship. This is too moderate a statement. The cost of one of the latest type of battleships now being built by the United States would very nearly finance for the next five years the whole proposed Appalachian forest enterprise. The cost of six or seven more battleships would pay for the great possible expenditure to which some believe this policy may lead and which so alarms Mr. Cannon and other watchdogs of the treasury.

But this is not the end of the story. In twenty-five years the Appalachian forests would pay the nation a good net return on the investment and they would increase in value, under proper forest management, from year to year, making a permanent addition to the national wealth. In twenty-five years the battleship would be fit only for the scrap heap, and during the period of its life its up-keep would have been a heavy expense to the nation.

In making this comparison, we do not need to enter into the question of the necessity of maintaining an adequate armament. The Peace Society made the comparison for one purpose—we make it to show that the nation that spends its millions annually for building new battleships that soon become obsolete and which will be useful only in the case of a problematical war, should not hesitate to make such investments as the proposed Appalachian legislation calls for for the sake of keeping its own house in order. The house owner who allows his property to go unpainted and without shingles and to fall into general disrepair, is regarded as incapable and as a poor business man. What shall be said of the nation that allows its property to run down from year to year? This we are

doing, and we have not the excuse of poverty or ignorance, for we have the example of other nations to guide us in the way of intelligent management.

The Growing of Eucalyptus

EUCALYPTUS growing in the southwest has assumed such considerable commercial importance that it is being exploited by numerous companies interested in selling lands for the purpose of growing trees. These enterprises when in reliable hands and under good management will probably have excellent prospects, and, as is always the case when some new investment field of this kind is being pushed to the front, it is necessary to guard against improper methods and incompetent management. The Department of Agriculture has found it necessary to issue a warning in regard to the misquotation of some of its publications dealing with eucalyptus. One of these publications, Circular 97, of the Forest Service, has been misrepresented as saying that California would in a few years be the only source of hardwood supply in the United States. Such a statement, the department says, "has never been made in any of its Forest Service publications, and is not considered a fact." The department statement further says that its "experts believe that there is promise of considerable success in the cultivation of eucalyptus trees in many parts of California, but estimates of profits and of growth have been attributed to the department which are unauthorized. There are many uncertainties connected with eucalyptus culture which the investor should take into account." Naturally, the department objects to being misrepresented and to having its name used in advertising enterprises of which it has no knowledge and the managers of which are not conscientious in making statements that will promote their business.

This whole question of eucalyptus growing is one of great interest and importance, and experts are now at work upon it in the southwest and in Florida to ascertain under what conditions it can be successfully carried on. Owing to the rapid growth of the tree, its habit of growth, and the usefulness of its wood, it can be cultivated when the conditions and climate and soil are favorable so as to produce commercial crops in a much shorter time than other trees; but, like every other plant product, there are limitations which must be known and allowed for if any particular enterprise is to be commercially successful. Those who intend to enter the field, or to invest in any of the eucalyptus projects should, therefore, inform themselves as to the actual conditions and as to the management, and not absorb too readily the prospectuses of promoters. AMERICAN FORESTRY will take up this subject in forthcoming issues and will endeavor to give its readers adequate and reliable information in regard to it.

NATIONAL FOREST WORK

Working on Administrative Problems

Associate Forester A. F. Potter has returned recently from a trip of about a month to confer with national forest officers on the administrative methods of the Forest Service and to take up with them the questions of changes in procedure considered desirable by the Secretary of Agriculture and the Forester. He visited the offices of the district foresters at Missoula, Mont., Portland, Oreg., Ogden, Utah, and Denver, Colo. At Missoula and Portland he attended meetings of all the forest supervisors of Montana, northern Idaho, Oregon, and Washington. Mr. Potter attended the meeting at Missoula during the early part of the week of March 21 to 26, and the meeting at Portland during the latter part of the same week.

Secretary Wilson is anxious that in applying the national forest policy the fullest consideration compatible with the welfare of the forests be given to users and to persons entitled under the land laws to patents of national forest land. The listing of agricultural lands within the national forests, permitted by the law of June 11, 1906, when the land is found to be actually more valuable for agricultural purposes than for its timber, is an established part of the Forest Service work. Complaint has been made in some quarters that forest officers have shown an excess of zeal in opposing bona fide claims, and that the Forest Service has been too strict in applying the law permitting agricultural settlement. While the great majority of such complaints have been found, on investigation, to be without just cause, Secretary Wilson regards it as worth while to inquire whether any modifications of the present procedure are called for to insure that his wishes are actually carried out.

This does not mean that any departure from the policies which have governed the administration of the national forests is contemplated. It may be, however, that the details of the administrative work require looking after in some particulars to insure that the decisions of field officers actually apply the principles laid down for the Forest Service, and it is to inquire into this matter that the Secretary authorized Mr. Potter to make his trip.

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Squatter Rights in National Forests

Secretary Wilson has just issued an order providing for a more liberal treatment of bona fide squatters upon unsurveyed land which has been included within national forests since the time of actual occupancy of the land by the squatter.

Under the homestead law it is impossible for any one to secure legal title to unsurveyed public land, but occupancy pending survey is recognized as giving a prior claim to the land after survey, under what is known as "squatters' rights." A squatter who had, in good faith, taken possession of a piece of national forest land before the national forests were created is not dispossessed of his claim by the Forest Service, and if he lives upon it and cultivates it until the land has been surveyed, he is able to get his homestead just as though he had settled on any part of the unreserved public domain. But since the passage of the Act of June 11, 1906, which permits the Secretary of Agriculture to list for settlement land which he finds chiefly valuable for agriculture, it has been possible for squatters to apply for the listing of their lands under this Act, and thus to obtain title prior to the government survey. The object of the new order of the Secretary is to provide for the listing of the full amount of land which the occupant would receive if he exercised his option of awaiting the government survey, irrespective of whether or not the entire area is cultivable, provided the claim is bona fide and the land is not more valuable for its timber than for agriculture.

Secretary Wilson's order is as follows: "A person who has settled upon and continuously occupied unsurveyed lands within a national forest before its creation and is at the present time occupying such lands in good faith and is in all respects complying with the homestead law, has the right to include within the lines of his homestead 160 acres after the land is surveyed. Therefore, if the land is occupied for agricultural purposes and is not more valuable for its timber than for such purposes, and there are no circumstances which would in the opinion of the District Forester tend to discredit the bona fides of the claimant, he should be allowed to make application for the patenting of such lands under the Act of June 11, 1906, and the examination for listing should be made with a view of listing 160 acres of land where possible. The tracts as listed should conform so far as practicable to the form of the public land surveys. The listing of lands as above should not in any way govern the determination of the total area or amount of non-cultivable land listed for applicants under the Act of June 11, 1906, who were not residing upon the land before the creation of the forest. In cases where less than 160 acres of land has been listed to a person who settled upon the

land prior to the creation of the forest, an additional area sufficient to complete the homestead entry may be allowed upon proper application."

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Grazing—Trespass on National Forests Still Criminally Actionable

The enforcement of the grazing regulations on the national forests is not affected by the recent decision of the Supreme Court of the United States, affirming the decision of District Judge Wellborn, of California. The position of the Secretary of Agriculture is set forth by Associate Forester Potter in the following letter to the District Forester at San Francisco:

"The decision of the United States District Court for the southern district of California in the case of the United States against Cazajous, Grimaud, and Inda has been affirmed by the Supreme Court of the United States by an even division of justices, there being four for affirmance and four against, the ninth member of the court not sitting. No written opinion was rendered, and could not be, in the nature of the case, because of the even division of the justices. Being evenly divided, the decision of the Supreme Court merely means an affirmance of the decision of the lower court in these particular cases, without any binding force in any subsequent cases that may arise for violation of the regulations of the Secretary of Agriulture governing grazing on the national forests. Therefore, you will continue the enforcement of the law and regulations and take the same action regarding any violations thereof as heretofore.

"In the event of a trespass case occurring in your district in which the circumstances are similar to those involved in these cases, you should proceed in accordance with the instructions relating to criminal trespass and if, upon presentation of the facts by the United States Attorney, the grand jury finds an indictment, and upon demurrer the decision of the court is in favor of the defendants, the United States Attorney will be instructed to remove the case to the Supreme Court of the United States for review. When the case reaches the Supreme Court, there will probably be a full bench and a final and authoritative decision of this court will be rendered."

In the decision rendered by Judge Wellborn sustaining the demurrer in the cases of Cazajous, Grimaud, and Inda, he did not question the right of the Secretary of Agriculture to control grazing upon the national forests, nor his right to prohibit any unpermitted grazing. That the Secretary has such authority had been expressly held by a higher court, the United States Circuit Court of Appeals of the Ninth Circuit, sitting at San Francisco, both in the case of Shannon *vs.* U. S. (120 Fed. Rep., 70), and in the earlier case of Dastervignes *vs.* U. S. (122 Fed. Rep., 30). Indeed, the authority of those decisions was expressly recognized by Judge Wellborn. These cases were, however, civil cases in which the United States was granted injunctions restraining the defendants from grazing trespass upon forest reservations, while the cases of Cazajous, Grimaud, and Inda, decided by Judge Wellborn at Fresno, were criminal prosecutions.

Judge Wellborn held that while the Secretary of Agriculture has full authority under existing laws of Congress to promulgate regulations prohibiting grazing upon national forests except under permits, and while the forests can be protected against any violation of such regulations, by the bringing of civil actions and suits for injunction, still a violation of the regulations cannot be held to be a crime. In other words, the decision of Judge Wellborn did not question the right of the Secretary of Agriculture to enforce by civil process proper observance of the grazing regulations, but held merely that violations of the regulations could not be made the basis of criminal action.

Under the Criminal Appeals Act of March 2, 1907 (34 Stat., 1246), the Attorney General has instructed the United States Attorney at Los Angeles to sue out writs of error at once and have Judge Wellborn's decision reviewed by the Supreme Court of the United States. This is the first opportunity the government has had to obtain a ruling upon this question by the Supreme Court. The appeal will be prosecuted to as early a decision as possible.

Judge Wellborn's ruling is directly contrary to decisions by the following courts, which have held that violations of the Secretary's regulations are criminal and may be the subject of criminal prosecution:

U. S. District Court, District of Idaho, in the case of U. S. *vs.* Domingo (152 Fed. Rep., 566), decision by Judge Beatty, March 14, 1907;

U. S. District Court, Northern District of California, in the case of U. S. *vs.* Dequirro (152 Fed. Rep., 568), decision by Judge DeHaven, October 2, 1906;

U. S. District Court, South Dakota, in the case of U. S. *vs.* Bale (156 Fed. Rep., 687), decision by Judge Carland, September 3, 1907;

The Supreme Court of Arizona, in the case of Dent *vs.* U. S. (76 Pac. Rep., 455), opinion by Chief Justice Kent;

United States Attorney-General, John W. Griggs, also held (22 Opinions of Attorneys-General, 266) that any violation of the grazing regulations constitutes a crime and may be prosecuted and punished as such.

As heretofore, the grazing regulations will continue to be vigorously enforced upon every forest. Any willful violation will be at once reported by the forest officers and prompt action will be taken. Past experience has shown that only upon very rare occasions indeed is court action necessary. The acknowledged justice and propriety of the graz-

ing regulations have generally appealed to the sense of fairness of forests users, with the result that willing compliance with, and hearty cooperation in the enforcement of, the regulations have been the rule, and cases of willful violation have been of rare occurrence.

The Use of Hickory in the United States

In cooperation with the National Hickory Association, the U. S. Department of Agriculture has just completed a canvass of the principal hickory-using establishments to ascertain their annual requirements. In the last few years the users of hickory have become very much alarmed over the decreasing supply; so far, however, it has been impossible to get satisfactory statistics either of the total quantity of hickory yet standing in the forests or of the amount used each year. This is partly because a great deal of hickory is cut by small portable or stationary mills, which, after consuming all the timber within a radius of from two to eight miles, are either sold or moved to new points. Much hickory is also split into billets for spokes, handles, etc., instead of being sawed into lumber. Altogether, therefore, it is extremely difficult to make even a fair estimate of the total hickory consumption.

While the figures gathered by the association and the department are not as complete as were desired, they are at least significant. Hickory is especially sought for the manufacture of vehicle parts and of handles, in which great strength and toughness, together with moderate weight, are essential. It is estimated that, in the manufacture of their special products, the hickory-using establishments consume the equivalent of the following:

Product	Board feet
For spokes	45,000,000
For handles	29,000,000
For poles and shafts	18,000,000
For rims	16,000,000
For singletrees, doubletrees, neckyokes, and bolsters	16,000,000
For axles	6,000,000
For sucker rods	1,000,000
For vehicle gear woods	600,000
Total	131,600,000

In addition to the hickory which is made directly into these special forms there is manufactured each year about 200,000,000 feet of hickory lumber, most of which is later remanufactured. The total quantity of hickory cut in the United States each year is therefore equivalent to not less than 330,000,000 board feet. According to the reports of the Bureau of the Census, the average value of hickory lumber at the mill is about $30 per thousand, while the high-grade material which is necessary for the special uses listed above is worth at least $50 per thousand. This makes the total value at the mill of the annual hickory production not less than $12,000,000.

Hickory is one of our most useful woods, but it constitutes only about two to five per cent of the total stand of timber in our hardwood forests. It is widely distributed throughout the eastern hardwood forests and was formerly most abundant and of unusually high quality in Indiana and Ohio. The supply in these states, however, has been greatly reduced by cutting, so that at present Arkansas is distinctly in the lead in hickory production, followed by Tennessee, and then by Indiana, Kentucky, and Ohio.

National Forest Work in Florida

Florida is about to get its first practical experience of the results of national forest administration. A reconnaissance survey of the Choctawhatchee Forest, which was put under control of the Department of Agriculture in November, 1908, by presidential proclamation, is now being made by a force of Forest Service experts. This survey will furnish information in the light of which use of the forests can be promoted through properly regulated timber cutting, through turpentining under the cup-and-gutter or the cup-and-apron method, and through grazing, without harm to the permanent value of the forests. Florida was the first state east of the Mississippi to have a national forest.

The Choctawhatchee Forest containing approximately 467,606 acres, is located in the western part of the state, along the Gulf, in Walton and Santa Rosa Counties. The Ocala Forest, embracing some 207,285 acres, lies in the central part, the greater portion of the forest being in Marion County, with a small fraction in Lake. The two forests were placed under administration November 1, 1909.

As long ago as 1825, Congress appropriated $10,000 to buy live oak land on Santa Rosa Sound to make sure of a supply of ship timber for our war vessels. This reservation, together with other tracts subsequently set aside, made a total of 208,224 acres in Florida timber lands which the government proposed to hold as a source of supply for its ships. Large quantities of acorns were planted and many young oaks set out. But the plantation was not a great success, and the main effort was ultimately restricted to thinning out, pruning, and other silvicultural care of the trees of the natural forest. Today the new attempt at forestry in the Peninsular State promises much more encouraging results.

The party of eight Forest Service cruisers, headed by A. B. Recknagel, Assistant Chief of Silviculture at Albuquerque, New Mexico, have already commenced operations near the head of Little Alaqua. The crew will proceed westward to the western border of East Bay River. An accurate survey of all the

government land will be taken, the stumpage estimated, and a report made of the number of turpentine cups that, in accordance with the latest federal regulations, may properly be placed on the forest.

When the cruisers have completed their work on the Choctawhatchee, a similar inspection of the Ocala Forest will be made. It is thought the surveys will engage the force until the beginning of summer. Sites have been selected for the rangers' houses, to be built by contract.

A local estimator figures that the country-school and road funds will profit by the turpentining, grazing, timber cutting, and other receipts of the Choctawhatchee Forest to the extent of $700 or $800 this first year, since twenty-five per cent of all such revenues is to go into these two funds.

The New Pine Tree Nursery of Montana

The Forest Service is to have a new nursery in Montana. The Savenac nursery, the twenty-fifth of its kind maintained by the Department of Agriculture for its forest work, is situated in the Lolo National Forest on Savenac Creek, Montana, near De Borgia. The ground was plowed and harrowed last fall, the irrigation ditches run, and an ample water system installed. The tract will be laid out in 150 beds, each four feet by twelve. Over these will be broadcast the best of the seeds of native conifers gathered in the forest the past autumn. To prevent mice and birds from eating the seeds each bed will be protected by a lath and wire frame. This will also serve to shade the delicate plantlets during the tender period of their first year's life. A water system will supply the means of sprinkling the seeds and irrigating the young trees during the warmer, drier months. One man will be kept constantly at work watering the thirsty soil and otherwise caring for his interesting charge.

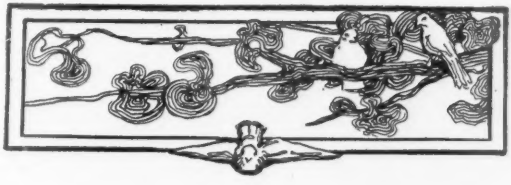
The Savenac nursery will have an annual productive capacity of 1,500,000 seedlings. When one year old—beginning probably in the spring of 1911—these will be set out in transplant beds, where they will be expected to develop in two more years into respectable young trees. Thence they will be removed to their permanent home in the hills of the Lolo National Forest. Planting and direct seeding will be done on the great burned areas visible to passengers on the trains of the Coeur d'Alene branch, and also on extensive burns around the head waters of the Rattlesnake River in the Missoula Forest. The work is designed to add to the national timber supply in the coming years and to aid in the regulation of the flow of Montana mountain waters. The Savenac nursery will bring the aggregate annual plant-producing capacity of the twenty-five national forest nurseries up to 10,000,000 seedlings.

Government Improving Forests

It will be a source of surprise to many who do not understand the work of the Forest Service to learn of the permanent improvement work which has been carried on in the National Forests. On the forests of Arkansas, Arizona, and New Mexico the Service spent during the last fiscal year $68,923.84 for permanent improvements. The primary object of expending money in this way is to make the forests more accessible to the public. Consequently a very large percentage of this money was spent in the construction and repair of roads and trails and many miles of telephone lines were also constructed. The report shows that a large percentage of the money was expended in the construction and repair of 253 miles of trails, thirty-two miles of wagon road, and 206 miles of telephone lines.

The stockmen residing within the boundaries of National Forests are receiving considerable help from the Service through the development of watering places.

The Service further helps stockmen by cooperating with them in the construction of drift fences, which aid stockmen in handling their stock.



STATE WORK

Colorado State Forestry Association

The following resolutions were adopted by the Colorado State Forestry Association, at its annual convention January 13th, held in the senate chamber of the capitol at Denver:

GIFFORD PINCHOT AND THE FOREST POLICY

"WHEREAS, Gifford Pinchot has accomplished a work of inestimable value in the conservation movement, and especially in forestry, therefore

"*Resolved*, That the Colorado State Forestry Association in convention assembled hereby expresses its appreciation and approval of the work accomplished by him in the past, and

"*Resolved*, That we express the hope that he may continue his valuable services in the cause of conservation, of which he is the recognized leader; and be it further

"*Resolved*, That we hope that his successor may carry out the forest policy, already inaugurated, and in this hope we extend to him our hearty welcome and earnest support."

WHITE MOUNTAIN AND APPALACHIAN FORESTS

"WHEREAS, the establishment of the proposed White Mountain and Appalachian National Forests would result in the protection of the sources of numerous rivers and streams, which are of priceless value for water power and navigation, and would result in the conservation of the forests thereon, and greatly increase the timber supply of a region which by nature is better adapted to the growing of valuable hardwoods than any other area in the United States, therefore

"*Resolved*, That this association urges the Congress of the United States to enact, at the earliest possible date, such laws as will result in the establishment of the aforesaid national forests."

The resolutions also approved the work of the Colorado Conservation Commission and asked that an appropriation be made by the state to render it more effective; urged the establishment of a national park and game preserve at Estes Park; commended the proposed forestry school at the State Agricultural College at Fort Collins and endorsed "the effort of Congressman Edward T. Taylor to secure the setting apart and granting to the said college by Congress of a suitable tract of timbered land from the public domain, conveniently located, for the permanent and perpetual use of such school, for forestry study, experimentation and the practice of forestry, for the advancement of the science and knowledge of forestry within our state," and urged the employment by the state of a technical and practical forester who shall investigate and make public report on (1) the amount, species, value and condition of the timber on all state and private land in Colorado, and (2) on the advisability and nature of such legislation as shall ensure the most efficient protection from forest fires of the timber lands owned by the state and by private individuals, and of such other legislation as shall encourage the practice of forestry on such lands.

Forest Fire Protection in Idaho

Reports submitted at the annual meetings of four timber protection associations of northern Idaho in the offices of A. L. Flewelling in Spokane, March 15 and 16, show that in an area of 6,300 square miles 17,000,000 feet of green timber and 290,000 feet of logs were destroyed by fire in 1909. These figures are embodied in the report prepared by A. W. Laird of the Potlatch Lumber Company, head of the North Idaho Forestry Association, composed of organizations in the Potlatch, Coeur d'Alene, Pend Oreille and Clearwater districts. After showing the benefits of protection given by the owners of timber tracts in Idaho, Mr. Laird said that of the total number of feet of timber affected by fires there is a small percentage which may be utilized with but little depreciation in value, adding in part:

"The total expense of the four forest fire associations in the panhandle was $51,251.94 last year, and of this amount $14,936.52 represents the wages of fire wardens or patrolmen; $5,472.73 was spent in clearing and building trails, $4,171.87 in fighting fires, and the balance, $26,670.82, was spent among our merchants and others for supplies, provisions, tools, camp equipment. A large sum found its way into the pockets of our homesteaders for board for patrolmen, horse feed, fresh vegetables, buttermilk and eggs.

"While the territory protected was more than 4,000,000 acres in extent, the entire expense was borne by the owners of 1,450,000 acres. The interests back of this great movement for the conservation of our timber protect two acres of timber from the devastation of forest fires for each acre which they themselves own.

"The experience we are gaining each year in the prevention and control of forest fires is greatly reducing the loss of timber from this cause. Our interest in the stumpage value of this timber is a mere bagatelle as compared with the interest of the community at large, for it is safe to say that in logging and manufacturing the timber now standing in the five northern counties of Idaho not less than $200,000,000, and more likely $300,000,000, will be paid out in the one item of wages to residents.

"Any one of the 322 forest fires which we successfully fought in 1909 with but small loss, or in fact any one of the thousands of small fires which were discovered by our patrolmen before any serious damage had been done, had it not been for the most excellent work of our men, might have developed into conflagrations which would have swept away hundreds of thousands of dollars of our investments, millions in the wages of our employes and caused untold loss in life and property of the residents of the locality.

"The moral as well as the financial support of the state board of land commissioners has been a potent factor in the success of the last year, as well as in previous years."

These trustees were elected for the North Idaho Forestry Association: President, A. W. Laird, Potlatch Lumber Company, re-elected; vice-president, J. P. McGoldrick, McGoldrick Lumber Company; secretary-treasurer, W. D. Humiston, Potlatch Lumber Company; T. J. Humbird, Humbird Lumber Company; C. P. Lindsley, Craig Mountain Lumber Company; E. N. Brown, Clearwater Lumber Company, and A. L. Flewelling, Monarch Lumber Company.

The Potlatch Association elected A. W. Laird, president; George A. Day, vice-president, and W. D. Humiston, secretary and treasurer. The directors are G. A. Day, C. H. Fancher, E. N. Brown, G. A. Rubedew and A. W. Laird. The president announced that the loss from fire in the Potlatch district last year was practically nothing, notwithstanding the danger caused by the clearing of a right of way for the Chicago, Milwaukee & Puget Sound Railway.

At the meeting of the Clearwater Fire Protective Association the following officers were elected: President, E. N. Brown; vice-president, G. A. Day; secretary and treasurer, B. E. Bush. The directors are E. N. Brown, G. A. Day, W. M. Deary and George R. Schofield.

The meetings were attended by James Turrish, Western Land Company; G. A. Rubedew, Rupp & Holland; E. M. Hoover, Payette Lumber and Manufacturing Company; F. A. Silcox, acting district forester, district No. 1, Forest Service; F. H. Fancher, Milwaukee Land Company; J. P. McGoldrick, McGoldrick Lumber Company; A. W. Laird, Potlatch Lumber Company; E. N. Brown, Clearwater Lumber Company; T. J. Humbird, Humbird Lumber Company; W. D. Humiston, Potlatch Lumber Company; F. J. Davis, Edward Rutledge Timber Company; George A. Day, state land commissioner; B. E. Brush, state of Idaho, and W. G. Weigle, government supervisor of the Coeur d'Alene forest reserve.

Kansas

The Arbor Day proclamation of Governor Stubbs of Kansas, deserves perpetuation as an appreciative eulogy of the tree:

ARBOR DAY PROCLAMATION

"The genial days of spring call to our memory again the duty we owe to that ancient and useful friend of man the tree.

"In all ages of the world it has been true to our interest and loyal to our service. It has furnished the cradles and coffins of our ancestors; tables for the king and cottager alike. It has given comfort and shelter to the peasant and the prince—to the pauper and the potentate.

"Trees are the royal family of the vegetable kingdom. Neither the quarry nor the mine has done more for civilization than the forest. Neither stone nor steel can outlive or outrival the usefulness of the tree. It is more useful to civilization than silver—more valuable to civilization than gold. It gives us food and fire and shelter; it gives us books and newspapers and a greater variety of the necessities and luxuries of life than any other article of ancient or modern commerce.

"Trees have always figured in our divine and patriotic relations. Among them the religion of man was born. Groves were the first cathedrals of our race. Birds singing in their boughs and branches gave us the first idea of sacred music and the choir. God planted them in Eden for the sustenance of our first parents. From their leaves were fashioned the first garments that covered their nakedness. When God's displeasure threatened the extinction of our race Noah looked into the forest and found there the means of salvation. It was under the oak tree that Jehovah conversed with a great man in Israel. It was in the tree tops that David heard the voice of the Lord. It was among the palms of the Garden of Gethsemane that Jesus spent the last evening of his life. The battle for American freedom was consummated under the apple tree of Appomattox.

"For centuries, and until man came to profit by its use, nature denied the tree to the greater part of Kansas. We are now learning how it conserves the moisture in our soil, that it changes and modifies our climate, that it gives beauty and charm to our landscape, that it can solve the problem of slides and drifts and floods, that it influences our civilization and adds materially to the wealth and happiness of the people.

"Therefore, I, W. R. Stubbs, Governor of the State of Kansas, in accordance with the

custom of my immediate predecessors, and the delightful sentiment of a better generation, do hereby ordain and proclaim that Friday, April the eighth, will be set apart and dedicated to the planting of trees throughout the state, and I do especially urge the 500,000 school children of Kansas to participate in the enterprise.

"W. R. STUBBS,
"Governor."

Ohio

The graduates of the Ohio State University forestry course will be qualified to perform valuable services to their own state if the proper encouragement is given. Ohio should secure and maintain forest reserves. There are large areas of cheap land on the watersheds of the state that should be perpetually forested. The service of these forested areas as natural reservoirs holding back flood waters and preventing drouth and the washing of the land would be very great. That the ripe timber taken off the land from time to time would pay an ample revenue has been demonstrated in the case of similar reserves. Doubtless Ohio has as great a need of the forestry service as any other state.—*The University News-Bulletin.*

Pennsylvania

Arbor Days have been named by the Governor of the Commonwealth, and on April 8 and 22, some attention will be given to tree planting by a very few devoted to the cause of forestation. The trees planted on these days are not sufficient in number to be considered in connection with forestation. If a state-wide boom for wayside trees could be inaugurated and Arbor Days converted into genuine working holidays for planting trees by the side of the roads of the state, a great change would soon be effected, and our shadeless, treeless country highways be converted into long avenues of shade and beauty.

Our laws provide for this wayside tree planting, but nothing is done about it. The shaded country roads seen elsewhere have inspired a desire to emulate them in this state. A sunburned, starving highway is easily made a shady lane, grateful to man and beast. If walnut, chestnut and hickory trees are planted there they will afford a beautiful setting for the street and their nuts will be appreciated and valued by boys and squirrels. Our native trees make good wayside trees in country districts and serve a double purpose.

Arbor Day is intended not so much to increase the number of trees as to increase the knowledge and love of trees and an understanding of their value among the people. The wider and more general is the observance of these special tree days the better it will be for the state and for the people who live in it.—*Philadelphia Press.*

NEWS AND NOTES

Foreign Planters Seek American Trees

The enterprise of German foresters and the importance of tree planting for forest purposes are strikingly shown by two items of news which come, the one from Montana, the other from Ontario. It is reported that a demand has developed for Montana larch seeds to be used by German nurserymen, while white pine seedlings are to be imported from Germany by the town of Guelph, Ont., for planting a 168-acre tract of land belonging to the municipality.

The Germans recognize that the introduction into their forests of valuable trees native to other countries may be decidedly to their advantage. Although as a rule the forest trees best adapted to each region are those which naturally grow in it, there are many exceptions. Norway spruce and Austrian and Scotch pine have been carried from their native home to other parts of Europe and to America and have been found well worth the attention of the grower of timber. Several of our own species have met with favor in Europe and flourished there, such as the Douglas fir, black walnut, and others. The Australian eucalyptus is proving a great find for America and South Africa.

Our own white pine long ago crossed the Atlantic in response to the needs of Europeans, whose forests are comparatively poor in tree species, and is now grown commercially on such a scale that when it is wanted for planting in its own native habitat the German nurserymen are often ready to deliver young plants here for a lower price than our own nurserymen will quote. Now the Germans are going to try the Western larch also. The request from the German nurseryman instructs the collectors to gather the choicest seeds when ripe this fall. One nurseryman on Flathead Lake has offered to exchange larch seeds for seeds of desirable German shrubs, which he intends to cultivate and sell in America. In the same region, four or five months ago, foresters of our own Department of Agriculture gathered seed for use in the neighboring Lolo Forest, where a new forest-planting nursery was begun last year.

The objects of the Guelph planting are, according to local accounts, to protect the town's water source by a forest cover over its springs in the hills, to make beautiful woods for a public park, and to provide for a future timber supply as a municipal asset. This follows the extensive work on the same broad grounds by the Metropolitan Water Board of Massachusetts. In foreign countries, forest tracts are often owned and managed by towns and cities as a paying investment and to insure a permanent supply of wood for local consumption. The kinds of trees to be grown in the Guelph park have already been decided upon by the Ontario Agricultural College. The proposed reforestation promises to be of so great economic and sanitary value that the estimated cost of $8 per acre for importing and planting the seedlings and caring for the growing trees is regarded as well worth while.

Trade in Pacific Coast Timber

San Pedro, a name almost unknown east of the Mississippi, is to-day one of the biggest lumber-receiving ports of the country, according to the figures of her collector of customs. The gazetteers of eight years ago assigned less than four lines of description to San Pedro. It was described as "a bay and inlet of the Pacific Ocean, in California, 105 miles southeast of Santa Barbara, thirty-three degrees, forty-eight minutes north." To-day it is known as the ocean port for the immense horticultural and commercial activity that centers about Los Angeles.

San Pedro's custom house figures show receipts last year of over 500 million board feet of lumber. This was largely redwood, Douglas fir, and yellow pine, brought in by coast vessels from the forests of the northwest. According to the Department of Commerce and Labor, New York's coastwise receipts of southern pine, for the year ended December 25, were a little under 490 million feet. Chicago received by water, for the full calendar year 1909, not quite 340 million feet of all kinds of lumber exclusive of logs; North Tonawanda, N. Y., received over 170 million; Ludington, Mich., nearly eighty million; Cleveland, about seventy-two million, and Detroit, a little over sixty-six million. The arrivals of redwood, pine, and fir, at all the ports of San Francisco Bay totaled 900 million feet.

The lumber arrivals at San Pedro are suggestive of the remarkably rapid development of southern California and also of the inland southwest. The fruit-growing section of southern California consumes much lumber, most of which is cut a full thousand miles to the north, but Washington, Idaho, and Oregon lumber is also distributed by rail from southern California to many inland points. Despite

the cost of the long ship transit added to the rail freight charges, the competition of lumber shippers who use the all-rail routes from the northwest coast states, or from the east, can be successfully met at several of these points by the ocean-and-rail route shippers.

The lumber business of the matchless forests of the northwest has been fighting against great odds in the Mississippi valley and eastern markets because of the cost of transportation. "In the Pacific Coast states, which contain so large a part of the total stand of national forest timber," says the Forester of the United States Department of Agriculture, in his Annual Report for 1909, "sales are made only when a fair price is offered and only under restrictions which safeguard the future welfare of the forest. Both these conditions tend to restrict sales in a region where timber is at present so abundant and so cheap. * * * The opening of the Panama Canal will of itself almost revolutionize the situation. Cuttings which cannot now be made in the best way for the welfare of the forest, because only the relatively high grades of timber can be sold, will then be practicable under much more favorable conditions."

The Pennsylvania Railroad Company's Forest Work

The Pennsylvania Railroad has planted 3,482,186 trees since it undertook forestry work on a comprehensive scale about eight years ago. In 1909 alone more than 1,000,000 trees were planted along the company's right of way.

Prior to last year, the forestry operations were confined to a limited area between Philadelphia and Altoona. In 1909, however, 7,800 trees were planted near Pomeroy, Pa., 188,200 in the vicinity of Vandyke, Pa., 35,000 near New Brunswick, N. J., 352,000 near Eyer, Pa., 30,000 near Metuchen, N. J., 161,825 at Denholm, Pa., 204,500 at Conewaga, Pa., and 74,500 at Parkton, Md. The total number of plants shipped from the company's forest nursery at Morrisville, Pa., was 1,240,381.

A special effort was directed to growing ornamental shrubbery, and 6,000 plants, imported from France, were placed in beds at the nursery. There are 56,000 trees and shrubs which are now being held in nursery.

This work, so far as trees are concerned, has been forced upon the company by the increasing shortage of cross-tie timber. Other companies are forestalling future scarcity in the same way, but none, we believe, on so large a scale as the Pennsylvania. Nor does this company, like some of the others confine itself to the cultivation of the quick-growing catalpa, but gives preference to black locust and red oak. And the effort is not confined to the cultivation of suitable timber, but involves the study and eradication of insect enemies of different trees and the perfection of wood preservative processes.

Forest Destruction

In his circular on the status of forestry in this country, Mr. Treadwell Cleveland, jr., of the Forest Service, assembles some notable facts. Speaking of the stocktaking of our forest resources, he says:

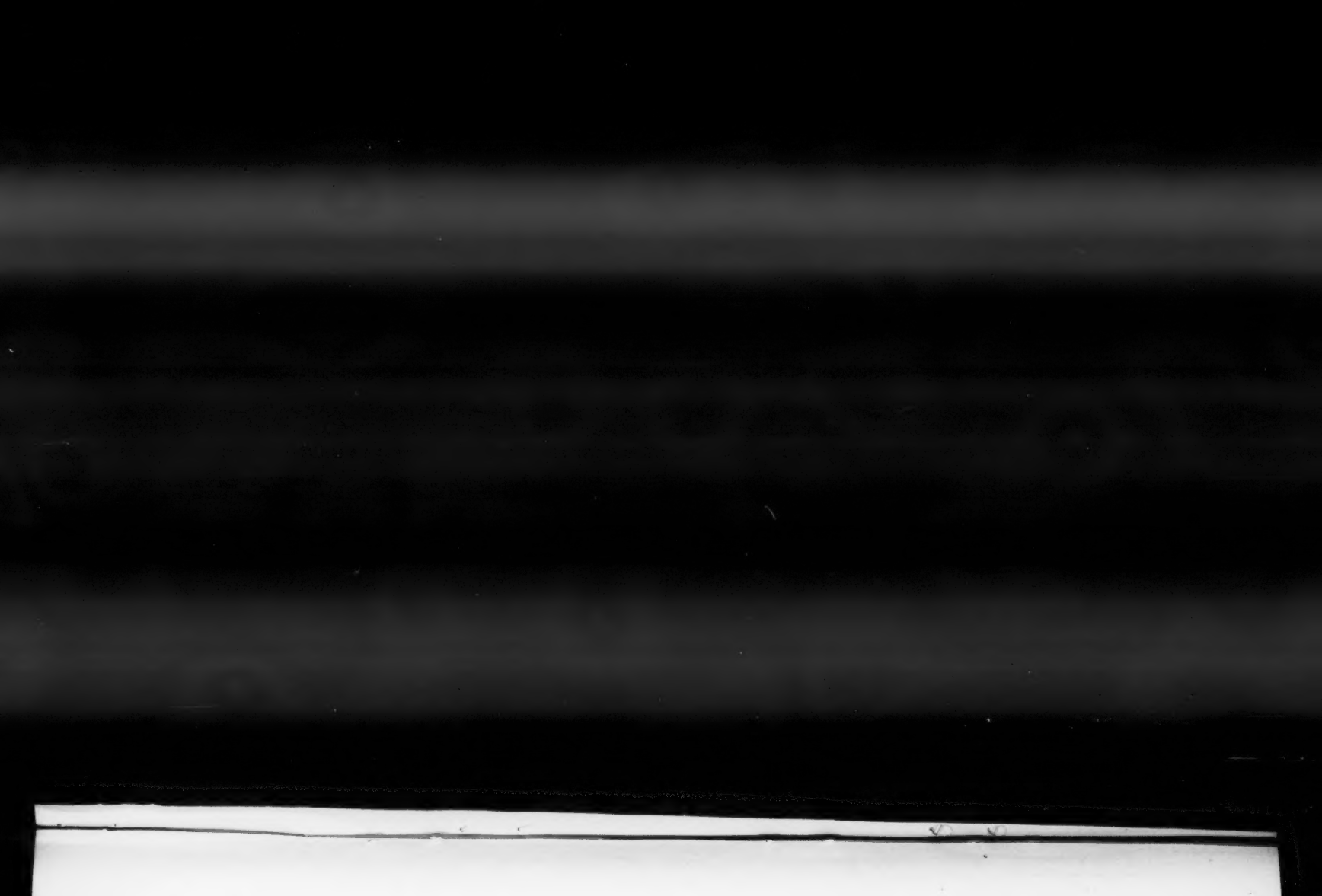
"It has shown that we are still destroying the forest as we used to; that we are taking from it every year three and a half times as much wood as is added by the new growth. It has shown that less than one-third of the growing tree felled by the lumberman is ever used at all, so that two-thirds of all the timber cut is simply destroyed.

"It has shown that one-eleventh of all the forests are swept by fires every year, and that on the average, since 1870, forest fires have yearly cost $50,000,000 in timber and fifty lives.

"It has shown that over ninety-nine per cent of the forests in private hands—which comprise three-fourths of all the forest land and four-fifths of all the wood—is thus devastated by destructive use and the scourge of unchecked fires, while less than one per cent is properly handled for successive crops or effectively protected from fire. The forest as a resource is rapidly being obliterated."

Bonds for Waterways

Speaking of the proposal to let Congress appropriate $100,000,000 for the improvement of waterways, the *Houston* (Tex.) *Post* says:

"One thing is evident, however. No Congress is apt to appropriate $100,000,000 for waterways out of current revenues. The revenue situation is entirely too precarious for that. Still, it would be entirely feasible to provide that sum, and even more, through the sale of low-interest-bearing bonds, such as are issued for the work on the Panama Canal.

"The sale of bonds for the purpose indicated would be good policy, certainly as justifiable as the sale of bonds for the work on the Isthmus. The importance of the isthmian canal to this country is going to be determined largely by the extent we improve our rivers and harbors. If it were a choice between the two, it would be more important to improve our own waterways than to dig the canal, but since both tasks are within our capacity, both ought to be completed as soon as possible."